

Aviation Week & Space Technology

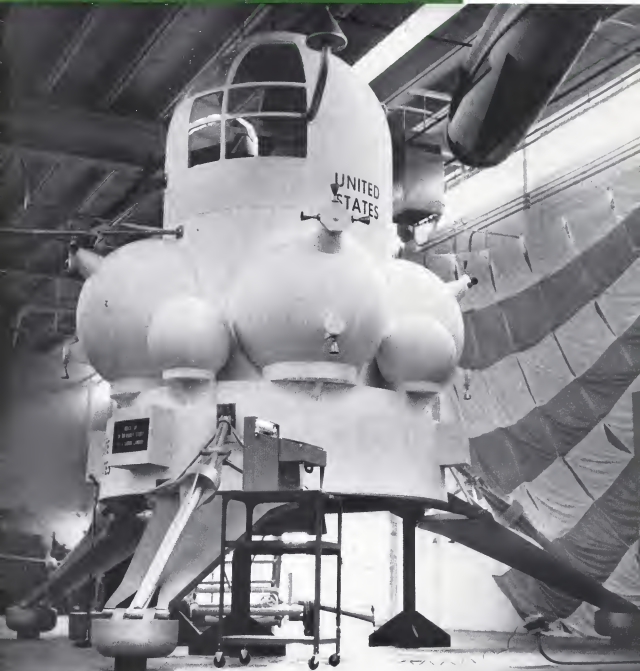
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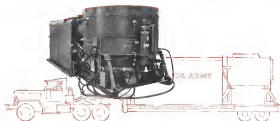
October 1, 1962

**Larger Space
Role Proposed
For Loran-C**

Lunar Excursion Module



From conception to demonstration at AGN...



ML-1: WORLD'S FIRST FULLY MOBILE NUCLEAR POWER PLANT

Aerjet-General Nucleonics is engaged in one of the most challenging projects ever assigned to an organization working in nuclear activities. The project, conceive, build and demonstrate a nuclear power plant powerful enough to supply 400 kw of electricity continuously for a year without refueling, compact enough to be transported by truck trailer, barge, or cargo plane, simple enough to be operated by a small crew of trained Army nuclear men, tough enough to withstand shock, vibration, pressure and environmental extremes and safe enough to be picked up and transported to a new site within hours after shutdown. One of the final stage generation of electricity by the demonstration ML-1, is limited.

The ML-1 is the smallest (40 tons) and hottest (1000°F) self-contained nuclear power plant ever to produce electricity.

and is the only plant in which the reactor is coupled directly to closed cycle high speed turbine machinery. It is gas cooled, and fueled with 90% UO₂.

Full responsibility for the ML-1 project was assigned by the Atomic Energy Commission to AGN under the Army Gas Cooled Reactor Systems Program. During management of the program, AGN has gained varied experience in all phases of lightweight, gas-cooled nuclear power plant design and production. AGN management is in high-temperature reactor technology, test experience, and project personnel also are being applied to studies of advanced ground power plants, space power systems, and nuclear ram jets.

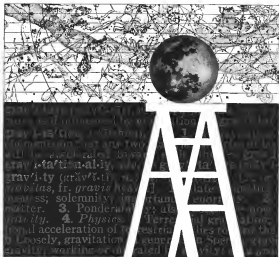
ML-1 is a joint project of the U. S. Atomic Energy Commission and the U. S. Army Corps of Engineers.



Aerjet-General Nucleonics is located on a 300 acre site in the San Ramon Valley near Livermore, California.



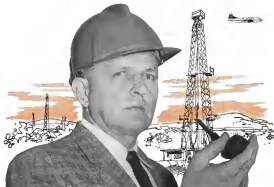
AERJET-GENERAL NUCLEONICS / San Ramon, California



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AEROSPACE CALENDAR

- Oct. 8-10-1961 Annual National Electronics
Conference & Exhibition, McCormick
Place, Chicago, Ill.
- Oct. 8-12-National Aeronautics & Space
Engineering & Manufacturing Meeting &
Display, Society of Automotive Engineers,
The Ambassador, Los Angeles, Calif.
- Oct. 9-13-National Airports Conference,
Aeromats Auto of Airport Executives,
University of Oklahoma, Norman, Okla.
- Oct. 10-12-Space in Flight & Rocket En-
gine Conference, Argentine Rocket So-
ciety, Palm Springs, Calif.
- Oct. 10-12-20th Annual Aerospace Elec-
tronics Symposium/Report, Aerospace
Electronics Society, Pan Pacific Auditor-
ium, Los Angeles, Calif.
- Oct. 12-13-Symposium on Photography of
Electricity, Dunlop Sheraton Hotel,
Washington, D. C. Sponsored by Society
of Photographic Scientists & Engineers, Na-
tional Bureau of Standards
- Oct. 15-17-Fall Meeting, International Sci-
entific Radio Union & Institute of Radio
Technics, Ottawa, Canada
- Oct. 15-17-ASW Meeting, Sheraton Hotel,
Bozina Mass. Sponsored by U.S. Navy
(Classified Secret)
- Oct. 15-16-International Symposium on
Space Phenomena and Measurement,
Starkweather, Denver, Mich. North At-
lantic Meeting, IRE, NASA, AEC
- Oct. 15-16-17th Annual Instrument Auto-
mation Conference & Exhibit, Instrument
Society of America, Columbia and Hotel
New Yorker, New York, N. Y.

(Continued on page 7)

AVIATION WEEK and Space Technology



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Retrospect

Ready, set...

How Lockheed helps U. S. Navy keep Polaris missiles in constant, combat-ready condition.

Polaris-bearing submarines roam the seas with a hell-or-HELL problem: systems programmed to launch targets—often for immediate launching. But the reliability of these submarines' fragile constant and complete readiness of their combat-ready Polaris warheads to maintain that state of instant readiness.

Special automatic Missile Test and Readiness Equipment (MYRE) provides this launching readiness. Conceived by the Special Projects Branch of the U. S. Navy, it incorporates sensing and instrumentation equipment developed by the creative design engineers of Lockheed Electronics Company.

Lockheed Electronics engineers used their long experience with Navy problems to create a preferred packaging

of this concept in a design best-suited for the rugged requirements of submarine environment.

Lockheed's experienced engineering follow-through teams are riding in installation and checkout, training Navy operators and maintenance personnel, and staying with the equipment until maximum performance and crew efficiency is achieved.

Lockheed Electronics offers these creative, pretested and follow-through capabilities to defense and civilian industries alike. LEC is the electronic pathway to several thousand scientific, engineering and technological who work for Lockheed.

Engineers and Scientists: For unique advancement opportunities with this talented team, please contact our Professional Placement Office, Plainfield, N. J.

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A Division of Lockheed Aircraft Corporation

Part of the function of this magazine, and this page in particular, is to alert various segments of the industry we serve to problems as soon as they are perceptible and occasionally to put the industry into facing problems it would rather ignore. We had that the manufacturing portion of the industry seems to understand this type of comment and accepts it generally in the spirit in which it is written. However, the air transport industry, with some notable exceptions, has been developed in an area of using self-satisfaction that regards an enhancement of its efforts, no matter how accurate or constructive, as less important. This attitude of a large part of the air transport industry, particularly its official representatives, has not deterred us from taking a direct approach to the industry's problems as well as. We will continue to publicly declare the plans of most airline people to help them solve the industry's very acute problems under a tag of "gentlemen's consensus of silence" or to indirectly blame the government for all its ills.

The airline industry, most of all because of its daily attention on thousands of people, needs increased sensitivity to its public image and should concentrate harder on projecting a feeling of mature intelligent management, both to its stockholders and its passengers. This has been, as we predicted a year of formal and changing trends in the air transport industry. We would be less than human if we did not take the opportunity that exists now present to remedy the waning will of airline management how many of the problems that they shrank from facing have now firmly straddled into their operations, and how many of the problems we were inclined to ignore have become the subject of drastic action by airline management.

Sales Staffs Shaken

For example, last winter (AW Feb. 5, p. 21), in an editorial entitled "Airline Sales Problems," we were so bold as to suggest that the energy expended in airline selling about the overcapacity problem created by the jet transport could be better applied to a major revision of its sales philosophies and methods, both of which were outdated obsolete by the technical revolution of the jet. We even suggested that some airline sales experts had been killed into a lake signal for their own ability by the sharply rising trend of population and economic activity during the past two decades, estimated with only a modest increase in seating capacity. The rapid increase in seat capacity, accelerated by the jet transport used a clear alternative—sell a lot more seats, or else. We received some pretty awkward ones over this comment from airline sales personnel, including some vice presidents of major airlines. We think it significant that several of the loudest protests against our exhibition to airline sales organizations to modernize for the jet age have been involved in the series of major shake-ups of airline's sales staffs that has characterized the latter half of the year.

Sell is another area that we warned could no longer be cloaked in a conspiracy of silence or modified with

meaningless statistics showing only a fraction of a person was killed per hundred million passenger miles flown. Our prediction that this outmoded approach to safety would no longer suffice as the jet age was confirmed by Sir Hudson Fyfe, chairman of Qantas Airlines and acting president of the International Air Transport Association and other speakers at its recent annual general meeting in Dublin (AW Sept. 17, pp. 21 and 38). The airlines are finally beginning to realize they must tackle this problem in a much more realistic manner, both internally and externally.

Passenger service is another subject that we have been harping on, much to some airline management's annoyance. Here again some airlines have faced the problem and made some drastic movement to simplify the nature of air travel for the passenger. Unfortunately enough they are finding the passengers flocking to their bars or larger quarters than ever and the empty seat problem becomes something for other airlines to worry about. But this average has not penetrated the air transport industry to reach the depth it must before real progress can be made in this direction. Too many airlines still think more champagne, orchids for the ladies, or a newly designed aircraft bag is the answer to passenger attraction. Traveling by air, whether on a short haul or long-haul operation or on an intercontinental jet stream, is still far too complicated a procedure for the traveler to make them look forward to it as a pleasure.

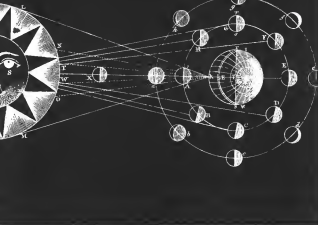
Applause for Lounges

Some time the airlines are going to have to step firmly into airport terminal building design to halt the current trend of making passengers walk a significant portion of their total stage length simply to reach an aircraft. What even their critical point the Dallas International Airport mobile lounge may show, they will surely be applauded by fastidious passengers arriving reluctant from mere things on concrete at other airports. Has any responsible airline official ever considered the simple solution to the twin problems of adequate ramp space and passengers' use feet long used in Europe with airport buses?

The increasing tempo of the world's economic and social life is creating a rapidly expanding demand for the services that airlines furnish to their jet passengers, can now supply. The airline problem is to supply it as terms that will attract the customer and not on terms that are simply a consequence for outmoded executive thinking.

Then we deliberately took an editorial snout at our airline critics of the past few years and challenge them to add up the score as to who was more accurate in predicting the problem and changing trends in the industry. In the meantime, we will continue to do our editorial best, both in reporting these changing times in air transport on our news pages as accurately as is humanly possible and in trying to dispense their portion on this page as a service to both the air transport industry and its passengers.

—Robert Helt



NEW DIMENSIONS IN SPACE

From early theories on space geometry, man's knowledge progressed to a finer appreciation of the universe and the challenging problems in its exploration.

Texas Instruments is applying its capabilities to an important part of the challenge—the problems of data acquisition, transmission, recovery, and display.

One of the newest technologies being brought to maturity in the Apparatus division is the expanded application of semiconductor network circuitry to space exploration equipment. TI's approach improves redundancy and simplifies circuitry—effectively extending equipment capability without increasing volume.

For more information write Marketing department—42.



Here is one example! This seven-chip PCM digital data signal conditioner (an integrated circuit network equivalent of 2200 components) Logic is performed by dual CMOS semiconductor networks—100 of them. This equipment has already been delivered to the Department of Physics and Astronomy at the State University of New York for an X-ray satellite experiment.

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WHO'S WHERE

In the Front Office

Dr. Guy Donati J. Pitt (ASST, enl.) a doctor, General Services, Fed. Adu. Civil Serv. Pitt is president of United Technology Corp.

William Lawrence executive vice president, Johnson Fin. Resources Inc., Boston. New research he was passed on to General Dynamics Military Products and Information Technology Division.

Carl W. Ruzicka, Jr. vice president, Controls and Service Division, Semiconductors Products, Inc., Kingston, N.Y.

Stanley A. Walter, vice president finance and accounts, Wyle Laboratories, El Segundo, Calif.

Edward A. Maling, vice president marketing, Treflex Inc., Springfield, Mass. is vice president, and Robert G. Chabing, vice president engineering.

Victor C. White, vice president and director of administration, Maxwell Int., South Pasadena, Calif.

J. N. Maffei, vice president personnel, Time World Authors, Inc., C. Ralph Fendley, vice president and secretary, Vantage, Van Nuys, Calif.

Dr. Herbert P. Mitchell, Jr. vice president advanced systems development, The Wykes Corp., Stamford, Conn.

Capt. Francis A. Stone, vice president flight operations, Eastern Air Lines, Inc., and Capt. Van C. Rensell and Lt. Richard D. Elford, deputy vice president flight operations.

Honors and Elections
Sen. George A. Southern (D-La.) has been named recipient of the Dr. J. Van C. Rensell Award for legislative leadership in air safety.

Harold A. Whorley vice president and director of Lockheed Co. and founder and president of Whorley Laboratories, Inc., a subsidiary has been appointed a member of the Defense Science Board by the Secretary of Defense.

Changes

General Dynamics/Fort Worth (Tex.) Division has announced the following appointments: **W. J. Allen**, director contracts, pricing and planning; **K. L. Johnson**, director flight and quality assurance; **J. J. Martin**, manager planning; **D. M. Johnson**, manager contracts; **V. E. Fink**, manager flight, safety and reliability.

Thomas A. Gillingham, Jr., international programs manager, is now vice president of Ford Motor Co. with office in Wash. region. **D. C. Wilkins S. Henry, Jr.**, vice president Mr. Cullen as manager of Aeromarine Eastern region.

A. L. Borch, manager, Systems Design, Western Electric, Aerospace Laboratories, Long, Tex.

Robert M. Wadsworth, director director of launch vehicles and propulsion, National Aeronautics and Space Administration's Marshall Space Flight Office, W. Stennis, is formerly with a Lockheed Chemical Co., Washington representative.

INDUSTRY OBSERVER

Army Ordnance Materiel Command has selected four companies to conduct studies on its Rocket program in a study from its original plan to request bids for several three-month studies (AW Sept. 24, p. 23). Douglas, Lockheed, Martin and North American Inc. have chosen to do the studies at \$250,000 each.

Perchell Cramer and Radio Corp. of America are leading contractors for development of the visual communications subsystem scheduled to be the camera payload for the Servicer orbiter. Present NASA funding forces going ahead with five \$300,000 Servicer orbiter to be booked into next year by the Air-Cannon. Alternative would have been to schedule two \$500,000 Servicer, mounted by Alt-Aragon B launchers, to get earlier shots in the series (AW July 23, p. 23).

Cardi Aircraft Design Team is developing a pilot-circled, tilt-wing VSTOL aircraft used at both urban and suburban airports. Work began about one year ago, and replace current aircraft. System is to enable aircraft design team is building an agricultural airplane, primarily for export to South American countries, which is expected to make its first flight early next year.

Proposals are due today for continued development of a low-cost electronic distance-measuring location system for the ground tracking vehicle of the Navy's surface-to-surface missile system. System is to enable accurate command post to location location of launchers with high precision. It was previously under development by Bell Telephone Corp. for General Dynamics/Pomona, prime contractor for the Army tactical missile.

Boeing Air Development Center plans a program to develop software for the comparison of two aerial photographs taken of the same area at different times. Purpose is to detect changes occurring from first photo was taken. Qualified companies must contact RADC by Oct. 1.

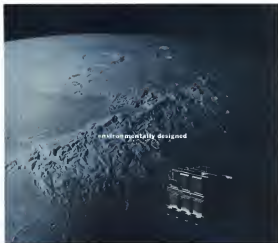
Advanced polycarbonate solid propellant being developed for Hughes GAR-9 missile by Lockheed Propulsion Co. (AW Sept. 17, p. 23) is expected to show specific impulse of 245 sec. and to withstand temperature cycling from 100°F to -75°F. Propellant was used in recent demonstration firing at Lockheed's Utah solid rocket motor.

USAF's Speed Air Warfare Center has taken delivery on a pair of Cessna T-37B aircraft for evaluation of their limited-war capabilities. Flares are used with four Sidewinders or other weapons including 50-cal. machine guns in underwing pods, 24 rounds of 2.75-in. disintegrating aircraft rockets in two 500-lb. bombs. Center also evaluating the two-engine Helio Model 580, designated U-5, in a VTOL-powered design.

Some by NASA scientists believe that work on nuclear optical jet space power and propulsion should be stopped temporarily in order to concentrate on more of the detailed problems still unsolved. They list solution and liquid nuclei as two specific subjects demanding much more knowledge as a basis for further system development.

Russians hydraulic vessel development includes the use of a water pit for propulsion, replacing the conventional screw propeller. A new 30-passenger hydrofoil boat will be powered this way, and is expected to reach speeds of about 50 kn. Russians say the new boat will be able to cruise in shallow water and narrow channels.

Army is showing increased interest in Doppler navigation system for its helicopters. Unofficially large number of Army helicopters were flown to test accuracy of the system in the Colorado after photo because lost on night VFR (Visual Flight Rules) flights. Doppler system are used for navigation and on Navy helicopters such as the Sikorski HO4S.



...to survive in space: the moon and a Librascope computer

Shore metaphors for floating in outer space is the first computer specifically designed to guide an exploring instrument package to a soft landing on the moon. It is one of a line of Librascope computers designed to perform in space vehicles and satellites. The premium demand for minimum weight is met with



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a variety of general-purpose digital computers. These computers are designed with maximum simplicity, compatibility with functional requirements and operate in their own corner with high reliability and long life. In space as well as at sea and in the air, Librascope computers pace man's speeding mind.

Lunar Bug Decision

Washington Roundup

Philips and technical lobbying are compelling selection of a contractor to build the manned lunar excursion module, or lunar bug, for the Apollo mission. Grassman and Martin led in the technical evaluation forwarded from the Manned Spacecraft Center at Houston, Tex., to James E. Webb, National Aeronautics and Space Administration chief, on Sept. 25. But the most of the eight bidders have good "land mark status" and the Kennedy Administration is paying closer attention than ever to contract awards because of the elections of the November elections (see p. 16). Winner will be announced by Oct. 15.

Evaluation team was to brief Webb last weekend so NASA could be made to make a formal presentation to the President's Science Advisory Committee on Oct. 3. Main reason for ISAC's interest is that Chairman Jerome Wiesner and his technical advisor, Nicholas Golovin, still are opposed to the lunar rendezvous method which NASA chose for getting to the moon (AW Sept. 17, p. 26). Because of this opposition, NASA had Space Technology Laboratories and McDonnell Aircraft conduct studies to direct ascent to the moon, using a two-man Apollo capsule boosted by a Saturn C-5 (AW Feb. 18, p. 12). Conclusion of the studies: the mission would have only a marginal chance of success.

Critical Centaur Choice

Decision on the future of the troubled Atlas Centaur launch vehicle program voted with the bug election at NASA last week after a sharp debate that pitted NASA's Space Systems Office against its Marshall Space Flight Center. Marshall contends that the vehicle's troubles are so extensive that it should be removed from the space systems program and made into a liquid-fueled test vehicle, at least until those or four test flights can show whether it would be useful later on. Marshall and the Saturn C-5—which is already fully committed to Apollo development flights through about 1967—could take on the 10 lunar and planetary missions now scheduled for Centaur. Space Systems Office wants the schedule to stay pretty much as it is. NASA's executive director after the House space subcommittee's determination whether the program "constitutes a good investment of additional time, money, and talent."

Wiesner launched Centaur 9 at an inclination of 68 deg. to the equator on Sept. 27. Only two other Centaur missiles have flown at that inclination. The last one, Centaur 7, which successfully preceded the flights of Vostok 3 and 4 and apparently was used to insure that radiation along that path would not harm cosmonauts. Apogee of Centaur 9 is 129 mi., perigee, 185, and period, 96 min.

Chinese Nuclear Tests

Communist China has admitted publicly that it is working on nuclear weapons. A Communist broadcast to Tokyo quoted Deputy Premier Chen I-an saying his country is engaged in large-scale nuclear experiments but that it could not reveal when it would conduct nuclear tests.

By late last week, Soviet Russia had conducted 37 tests since Aug. 5 that Atomic Energy Commission commented on specifically, plus enough others that AEC refers to the tests as "intensive." The Aug. 5 test had a yield of 10 megatons, AEC said. Second and third largest shots up to Sept. 25 were in the same megaton range. Five more were at several megatons, two were described as having yields of "a few megatons." On Sept. 27, Russia exploded a device that AEC said had a yield of less than 30 megatons.

At least 60 aerospace firms have received offers and company representations in Houston to work on launchers with the Manned Spacecraft Center. Another 20 to 25 companies have indicated that they plan to open offices there and at least one—Raytheon—has said it plans to establish an electronics laboratory in the city. Apollo manned lunar landing project being run from Houston now has about 5,000 firms and some 300,000 military personnel. NSC Director Robert McNamara told President Kennedy on the day McNamara's recent visit.

Selected Short Subjects

Air Force has vociferously recommended to defense contractors a way to avoid submitting files for security review and having them returned with only the title and credits approved. It suggests that any one who plans a file that will have to be reviewed should send three copies of the script through the usual channels for approval before submitting the file to production.

President Kennedy apparently has no more luck at getting information from Assistant Secretary of Defense for Public Affairs Arthur Schlesinger than he did. A questionnaire asked the President at a White House conference last week how reports could obtain copies of the May 23 space survey directive (AW May 18, p. 30), which deals with release of military satellite information. The President said he would ask Schlesinger about it. The questioner said he had already done that. The President replied: "Fine. I will tell to him, with no action, I am sure."

—Washington Staff

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BEECH MODEL 120 is powered by two 907-hp. Turbomeca T46 turbo-prop engines. Eight-place aircraft, which will sell for less than \$100,000, will be offered in four configurations. Construction employs semi-spine wing and fuselage design throughout interior.

Beech Shows Full-Size Model 120 Mockup

By Eowia J. Sullivan

Wichita, Kan.—Beech Aircraft Corp. opened its eighth-generation on the new eight-place, twin-turboprop-powered Model 120 executive transport last week with formal unveiling at a crowded, all-star, full-size mockup here.

A week earlier, Beech bricked about 50 distributors and their top personnel on the new airplane.

Mockup is one of the most detailed ever constructed, directly depicting the airplane as it will be built, down to placement of stringers, bulkheads, installation of systems and cockpit equipment, including actual instruments.

The aircraft's cabin is completely finished.

Current proposal is to keep the mockup in Wichita in a specially designed display area adjacent to the plant. That will provide prospective customers with a permanent opportunity to study the aircraft in detail with full technical and management support through late this year. This schedule possibly will preclude exhibiting the full-size mockup elsewhere.

Building of the detailed mockup has paid a dividend to Beech engineers and workers associated with the project by providing valuable experience that can be used in designing engineering models to construct the actual prototype. This is eating considerable time from the drawing board-to-production cycle. It also provides first-hand knowledge of some fabrication problems that cannot readily be foreseen.

First flight was originally scheduled

for early 1984 and delivery of certification production aircraft to customers not set for 1985. However, the intensive experience gained through building the mockup may cause these dates to be moved ahead somewhat.

Powered by two 917-hp. Turbomeca T46 turbo-prop engines, the new Beech Model 120 will sell for less than \$100,000. Fully equipped with cabin furnishings and electronics. With several standard items of flight experience already behind it, the Beech 120 is undergoing an additional 10-to-15-day service program.

Initially, the preflight run have

range-overhaul of 750 to 1,000 hr. It is also expected that, following the usual procedure of having overhaul time on average experience, the Beech 120 will eventually reach 2,000 hr service before overhaul.

Beech engineers based the Model 120 design on providing an airplane that will be capable of meeting Federal Aviation Agency requirements for certification under Civil Air Regulations Part 1, with a 3:1 load factor. Structure life is considered in infinite. Construction employs a semi-spine wing and fuselage design in the entire aircraft.

Model 120 is being considered for marketing in five configurations—ranging in takeoff weight and equipment installation—based on a standard empty weight of 6,075 lb, and a maximum gross weight of 12,603 lb.

Parted gear capabilities will vary, including provision for retractable gear to include usual allowances for the maximum and adding 100 lb reserves of 200 mi down to 40 mi. But the optimum configuration, with a full complement of six passengers and two crew members, provides for a 1,500-mi. maximum range with these fuel reserves at a 175-mpg, best average cruise at 21,000 ft.

Estimated gross weight performance also includes a two-engine rate of climb from sea level of 2,200 fpm. With one engine out, climb rate is still 810 fpm. To clear a 50-ft obstacle at sea level, will require 2,700 ft from start of obstacle. Landing distance over a 50-ft obstacle at sea level with approximately 12,000 lb. weight will be a little more than 2,300 ft.

AIA-Rocket Society Controversy Growing Over Technical Displays

New York—Controversy between American Rocket Society and the Aerospace Industries Association over displays at technical meetings is coming to a head as the date of the society's annual meet nears approach.

Based on the argument is a pair of resolutions adopted by the AIA last November. First of these requests member companies "...to avoid the costly exhibition of aerospace products" at technical society meetings.

Second resolution "...deplores the ineffectuality of exhibition of defense products" and "... recommends to its [AIA's] members that participation in exhibitions at the United States meet endorsed by the AIA or formally requested by DOD or NASA be also noted, or reduced to the minimum extent possible."

Wasting of both resources would not prohibit participation in a conference, which appears that is less relevant to participants to the maximum extent possible or that an exhibit is not certified. At least 24 big AIA companies have bought display space at the ARS since the Post Office Auditorium, Los Angeles, Nov. 15-16.

ARS is trying to convince some of the heaviest companies that their participation in the display program of the meeting is not only profitable but a very desirable adjunct to the meeting.

New this year to the ARS meeting is the concept of the "technical display," which is a simple show case or counter display for a company, which is a requirement to the exhibitor, a very desirable adjunct to the meeting.

In response to some criticism of displays at last year's Space Flight Report in the State of New York, the society decided to encourage the technical display as one means of providing additional information not easily presented by the author of a technical paper.

Most of these technical displays are now planned as lecture and demonstration tours. They are not necessarily one-time company's booth with live technicians and a laboratory for the lecture. One plan will use the same basic setup with charts or models included for the demonstration. Some exhibits and perhaps expense displays have been planned for the meeting.

The kind of display is to a display, ARS says, is a valuable aid to the easy and rapid transfer of technical knowledge.

Among the displays planned for this year's meeting: Series by United Tech-

nology Corp. on the latest concepts in solid-rocket motor technology; Space Technology Laboratories' demonstration of the Orbital Geophysical Observatory; descriptions of products for Russia (through 10) by Hughes Corp. of America; Republic Aviation Corp.'s lectures on Private Fuel and Jet-2 developed for the Apollo program; Martin Marietta lecture on Titan 3 (Boeing CSM) and a Saturn A5 program report by Douglas Aircraft.

House Group Backs Defense Supply Unit

Washington—Effectiveness of the newly-established Defense Supply Agency will be tested next significantly by the way it manages aerodynamically space parts, House Government Operations and Oversight Subcommittee, Senate, some said as a report to Congress on the agency.

The aeronomical supplies and aeronomical parts commodity group is probably one of the most difficult to be divided in order to define the future use, scope and status of the Defense Supply Agency, the subcommittee said in a report endorsing the centralized supply agency that was established by Defense Secretary Robert S. McNamara on Nov. 6, 1961.

Defense is studying the \$80,000 items included in the industry's inventory of aeronomical parts to determine which items may be moved to the DSA and then distributed as needed to the individual services. General Accounting Office long has questioned that centralized procurement of these parts could save costs but also increase wastage for the services.

The subcommittee endorsed DSA's studies on entering the aeronomical parts field. The potential DSA role could provide past savings but also increase wastage for the services, the report said. The subcommittee then said that DSA was approaching the task "properly" because of the apprehensions of the individual services toward the expanding role of the supply agency. Report in a pilot study of aeronomical space parts supply is expected to be given to Defense Secretary McNamara this month.

In contrast to an Aug. 4 report of a special House panel on aerospace activities, the subcommittee's study said that the establishment of DSA "should not be viewed with alarm, in terms of the continuation of the past, at a frantic search for supply."

The committee supports a continued aggres-

sive effort of the DSA to acquire new responsibilities and to develop improved management methods for common supplies and services. [DSA] can become the first agency able to provide reasonably accurate data for optimum allocation of the aerospace supply and service resources upon which all aviation companies will have competing requirements."

The armed services' administration has denied the Defense Department's contention that the subcommittee said that this trend could lead to a fourth unit.

In appropriations before recent congressional sessions, McNamara and DSA officials said that the agency's first year—\$277 million in fiscal 1963 alone. The subcommittee report detailed how Defense moved at this time of savings. Defense asked each service to estimate how much their supply activities would cost in fiscal 1963 by using common methods. The services estimated the cost at \$205.4 million.

Defense then estimated DSA could do the job for \$177.5 million, or \$27.7 million less.

Rep. Adam Joseph M. Latta, DSA, defense director told the subcommittee in Nov. 14 that the estimate was based on saving \$100 million for the supply activities. In its report, the subcommittee said the estimates are subject to uncertainty, adding "in the final count of personnel allocation, there are many difficulties which are not apparent from the estimates of costs and personnel strength."

Mississippi Test Site Development Detailed

Washington—First construction phase of National Aeronautics and Space Administration's Mississippi Test Facility will include study in state of Mississippi.

Development plan, announced Sept. 25 in NASA, involves construction of about 11 sq. miles at the facility in that large area of the state, directly in test stands. The 141,300-acre test site is 15 mi. from NASA's Midland manufacturing plant, where the stages will be assembled.

The \$300-million first construction phase will be completion of the first of two North American S-1 pads in early 1965, and the first of two Boeing S-4C stands in mid-1965. Each test stand will have two firing positions, and the S-1 and S-4C campaign will be completed by \$300 M.

The test facility [AW Mar. 25, p. 54] will be used to start test stages of the Nova boost vehicle as well as the Saturn C-5.

U.S. Watches for Possible Cuban IRBMs

By Larry Booda

Washington—Pentagon strategists consider the present arms buildup in Cuba the first step in a broad reconnaissance of intercontinental ballistic missile capabilities.

They point out that the defense value of treatments arriving from Soviet Russia is aimed at penetrating aerial photographic reconnaissance, not at preparation to fend off an invasion, although they could be used to spot resources.

If the information source is that of the construction of missile sites could begin in secrecy, this, since, if becoming operational, these missiles, if given a 1,200 nautical mile capability, could hit targets as far west as Boston, Detroit, Chicago, Chicago, Kansas City, Wichita, Oklahoma City, Amarillo and El Paso.

Reconnaissance Missions

Although daily photographic reconnaissance missions are being flown over Cuba, it was dramatically demonstrated early this month that missile reconnaissance can spot aircraft. Twelve reconnaissance aircraft (RAM) were spotted in the Havana area one day that had not been observed the day before.

Official estimates of total armaments and improved personnel, in addition to the SAM missile, that have arrived in Cuba since Russia's invasion of Czechoslovakia.

• **MC-130E aircraft:** These are about 70 MC-130E in operation. About 40 are MC-130E and most of the remainder are MC-130E. At least one MC-130E is being used in the air, and one is being used in the air.

• **Small arms and military transport equipment:** Heavy shipments from Russia began arriving late in July and have been continuing ever since.

• **Small arms and military transport equipment:** Heavy shipments from Russia began arriving late in July and have been continuing ever since.

The strategists readily admit that the present figures probably would have little effect in stopping reconnaissance missions over Cuba at supersonic speeds and altitudes of 50,000 ft and above. However, the SAMs, which normally

the Soviet Nike family of surface-to-air missiles, could pose a much more serious threat.

Cuba's personnel could be trained with both types of defense weapons with the aim of better replacing present equipment with new models capable of higher performance.

• **Missile torpedos:** Both armed with 10-m range missiles. The latter have higher speed.

• **Shore-to-shore missiles:** with a range of 20 to 100 km. One replacement has been located at Baco, on the opposite side of the island from Guantanamo Bay.

Cuban Premier Fidel Castro announced last week that Cuba will build a "living port" for Russian Havana. Radio Hanoi said that the Russians will be building the port at Havana Bay and will include a radio station and special gear for loading and unloading "all types of equipment." It could become a base for Soviet nuclear-armed submarines and for the heavily reinforced Soviet fishing trawlers that are being utilized for electronic monitoring along U.S. East Coast military installations.

Russian delivery of equipment and supplies to Cuba began in the summer of 1961, following the abortive invasion attempt in April of that year. Early this year there was a lull in the deliveries, which resumed early last July.

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Most of the cargo has gone to the port of Havana, which is on the north coast 160 nautical miles from the island's southern tip. Ships have also sailed into the harbor of Santiago de Cuba, on the north coast 95 nautical miles west of the southern tip of Cuba and 40 nautical miles from the U.S. Naval Base at Guantanamo Bay. Air cargo to the south coast 115 nautical miles east of Havana.

Most of the equipment carried in the cargo vessels consisted of transportation vehicles, electronic gear and construction equipment. The cargo was configured to carry radar, communications and generator equipment, such as would be used to control air defense units. Large crates apparently contained the SAM missiles and their launchers.

Two other torpedos boats (MTB) were part of the cargo. It is believed that their principal use will be coastal patrol armed with missiles.

There have been considerable reports

on the nature of the Soviet military personnel in Cuba. Some reports stated they were combat troops in uniform. Informal sources state that there are a mixture of military and civilian technicians sent to help the Cubans learn to operate the Soviet equipment. There is no solid information to indicate that any were combat troops.

Adding to the confusion was the appearance of what refugees called Cuban Communists. The same official sources say that several appearing personally, were leaving signs and marking on railroads in western Cuba, which are experts in rice and other agricultural crops. The United States is not sure if the Communists are sent to indoctrinate them in communism.

One of the toughest points in dealing with Cuba is violation of an airspace over the island, which has inside the Caribbean sea, measuring 615 nautical miles east to west, 81 nautical miles north to south and 25 nautical miles at Havana, toward the western end.

The entrance of the U.S. Naval Base at Guantanamo Bay on the south shore 55 nautical miles from the entrance point of Cuba provides the basis for the complaint. Guantanamo Bay is a fleet training base, and as such, has two facilities which automatically house the aircraft of attack and reconnaissance missions. The recent arrival of the Soviet fleet, including the nuclear submarine, is a great setback.

As traffic procedures in and out of Guantanamo Bay strict, restrictions on the movement of Cuban territory, even down to the end of the jet runway, comes very close to the boundary line.

The United States has listed Guantanamo Bay from the Republic of Cuba since 1901. Another treaty was signed in 1934 granting a perpetual lease to the U.S. The reservations contain 23,517 acres, of which 9,000 are under international air routes over Cuba are controlled by international agreement. Most different airlines see them with traffic flying to and from the U.S. to the Caribbean, Central America and South America areas. Restrictions of aircraft other than those under air route 1414 restricts the base from the use of commercial airlines.

Officially, the U.S. does not violate of Cuban airspace. However, it has been learned that reconnaissance missions are being flown regularly over Cuba by

An F-4 Phantom II aircraft, including the U.S. with its electronic capability of over 60,000 ft. Continuous analysis by photographic interpretation provides a day-by-day picture of happenings on the island.

Aerial photography has grown in sophistication so that good results can be obtained without involving a target area. In the case of Cuba, aircraft could fly at 15,000 feet or more off the coast and take oblique photographs. From U.S. or other fighter altitudes the oblique angle would be small. Prints could be made from the negatives using sophisticated lenses. These prints then could be interpreted as close as to get depth perception.

The island of Cuba is excellent for aerial photographic reconnaissance. Much of the coastal part of the island is mountainous. Some parts of the mountains are heavily wooded, but for the most part they are almost bare, with coconuts as the principal growth. The foothills are agricultural productive and swampy in some spots. Railroad is moderate, and the transportation dense. It is difficult to see any of the island from the air.

Military analysts say that the best location for IRBM sites are the mountainous regions, although they could be located in the lowlands. In either case, construction of the sites would have to be done in the lowlands or built in low spots in woods or fields. A sophisticated approach to this construction would include camouflage to fool aerial cameras.

An informed defense source said last week that the Cuban union building is not a secret threat to the U.S. He freely, he said, the building is great because Cuba had little to begin with. A for greater things, by assisting in the construction in Cuba, where Soviet blue arms are a real threat.

In addition to Soviet ships, a large number of ships from reconnaissance aircraft are carrying a variety of exchange goods into Cuban ports. Many of these ships have been loaded in their ports by the U.S. Since air under charter to reconnaissance blue nations. The official approach to this problem has been to say that, in light of our own trade interests, we do not let our friends trading with Cuba and using our own ships, but we will not use coercion to out it off.

The North Atlantic Treaty nations (NATO) with Cuba accounted for \$15 million in imports from Cuba in 1961 and \$85 million in exports to Cuba during the same year. London is the trade with the United Kingdom, West Germany, France, Canada and The Netherlands. Reports for the current year indicate a drastic reduction in this trade.

Goods represented in this trade were raw materials, chemicals, industrial raw materials, steel and other.



Model Shows Configuration of RS-28

First photos of North American RS-28 (reconnaissance-attack) show model of turbojet-powered version of T-28, one of which will be converted into one configuration in North American's California (OAS) Division and is expected to fly by Jan. 1, 1967. RS-28 (initially designated RA-28-reconnaissance attack) will be powered by a 2,400-hp T-28 turbojet engine on 11.5-ft-dia. Turbopropeller propeller and will be capable of carrying up to 1,000 lb of various external stores, including empty weight of 14,000 lb. Two 10-in. machine guns are carried in underwing pods and machine feed tanks, rockets, missiles or bombs can be fitted to wing pods. RS-28 maximum speed is calculated at 111 kt, cruise speed from 180 kt to 240 kt depending upon mission and loading. Rate of climb is calculated at 1,510 ft/min. Takeoff run weight is 13,500 lb. Empty weight is 11,710 lb. Normal maximum fuel is planned at 400 gal, with external tanks up to 600 gal, one or more. Ferry range with normal tanks is up to 2,400 nautical miles. Operational reconnaissance-attack missions are calculated at approximately 180 nautical miles. Dimensions include wingspan of 40.6 ft, length of 35.7 ft, height 12.7 ft. Computer study has converted 147 RS-28s from T-28s loaded with reconnaissance-attack aircraft and estimated that approximately 135 T-28s are now available for use in the other parts of the T-28 or turbojet-powered RS-28 configuration. U.S. Army is currently evaluating Soviet T-28s for loaded mission. USAF wants 2 RS-28s in United States Air Command's Special Air Warfare Center, Eglin AFB, Fla. (AW Jan 25, p. 74).



Telstar Folds Unusually High Radiation

By Philip J. Kline

Bell System's Telstar communications satellite is encountering about 10 times as many high-energy electrons as had been expected, at least one-fourth of them with energies higher than one million electron volts (mev), according to data obtained from the satellite's onboard detectors.

The energetic electrons, encountered at altitudes of 1,200 to 2,900 mi.—Telstar's apogee—have a peak concentration flux of about one billion per cubic centimeter per second at energies above 0.7 mev, according to Bell Telephone Laboratories scientists.

The higher than expected density of energetic electrons has been attributed to the U.S. high-altitude Soviet reconnaissance satellite July 12. The Atomic Energy Commission recently disclosed that Soviet satellites occurred at an altitude of about 250 mi and had a yield of 1.4 megatons.

Wager Knowledge

But because of the relatively meager knowledge of the energy levels and density of energetic particles in the outer Van Allen belt, their variation due to natural causes, scientists are reluctant to draw firm conclusions at this time. The radiation measurements which Telstar can make are relatively

meagre, since it was not designed primarily for this purpose. But because it is nonetheless the only existing source of radiation data now operating, its data is precious and timely indeed.

Telstar is continuing to perform its intended mission to permit continuous on-orbit experiments, despite an upper cut failure of an auxiliary circuit within the satellite. Telstar carries two sets of measured currents and densities, one of which serves as a standby. Upon command from the ground, the mainline counting circuit is supposed to check to determine if both currents and densities are in operable condition. The failure means that scientists can no longer tell if both currents and densities are functioning properly, but otherwise it has no adverse effect. RTL said.

Although both high-energy electrons and protons degrade the performance of solar cells, the radiation-resistant New-E type cells loaded with uranium oxides and on Telstar are most vulnerable to the protons with energies above 15 mev.

Telstar has reported peak proton densities of 20,000/cm²/sec at energies of 20-30 mev, comparable to data obtained from previous satellite radiation measurements. But the density appears to fall off sharply at higher altitudes. From the data obtained, RTL scientists estimate that the high-energy proton density at 6,000 mi. altitude is about 100/cm²/sec, and at 10,000 mi. altitude, for comparison, is only 1/300th the peak density at low altitudes.

Available Data

It is not possible, however, to estimate the level of energetic electrons at 6,000 mi. altitude from available Telstar data, RTL said. The current uncertainty over the extent of man-made radiation resulting from the Starfish test emphasizes the relatively meager data which has been obtained on the outer Van Allen radiation to date.

A recent report issued jointly by the Atomic Energy Commission, NASA and Defense Department says that the peak flux, which was reported by Telstar, is about 10 times the maximum ever obtained in the outer Van Allen belt and a factor of 100 above the most maximum recorded flux. "But the variations in the natural belt are even less well known than are the characteristics of the new belt of artificially injected electrons," the report said.

These figures may be low by a factor of two, or high by a factor of two to four, the report pointed out.

The expected lifetime of the man-made radiation depends in large part on

its altitude and the strength density. Atmospheric density varies by a factor of 10 from daytime to night, and is believed to vary by a factor of about 200 over a five-year interval between maximum and minimum solar activity, the report points out.

The greater number of stored man-made electrons are expected to have a lifetime that is comparable to electrons making up the natural Van Allen belt, the report said. These lifetimes are believed to be many years, with a half-life of 20 years being representative of electrons whose altitude is about 1,600 mi. at the equator, it said.

In the more than two months that Telstar has been in orbit, its solar cells have had their gross output cut by about 15% as a result of radiation doses and other causes, RTL said. However, this is within the range of degradation for which allowance was made in the satellite design.

Degradation Rate

The rate of degradation is expected to decrease in the future, and the cells are now expected to be delivering about 60% of their original power output at the end of two years. The satellite was designed to operate satisfactorily with up to 50% loss of original power.

Satellite temperature is expected, RTL said. The day temperature varies from 70° to 50°° while the night temperature ranges between 60° and 70°° internal temperature is controlled by automatic devices which increase or decrease infrared heat radiation to space.

Radiation Test Shots

Santa Monica-CALIF. will launch the satellite and a probe before the end of the year into the artificial radiation belt created by the July 9 high altitude air shot detonation.

Special payloads are a probe, to be launched by an Argo D-4 from either Point Arguilla, Calif., or Wallops Island, Va., and the SRE satellite, to be launched by a Delta from Cape Canaveral, FLA Sept. 17, p. 20.

As an E.S. geostationary satellite will be modified in a month of the new belt to include 60 solar cell experiments using quartz and silicon detectors. Slight modifications also will be made to Rely solar cells to measure degradation.

The SRA energetic particle satellite, scheduled for launch this week, and a military satellite also will measure the belt.

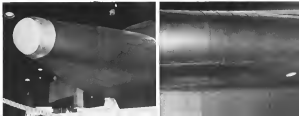
The SRE satellite has a backup, designated S-9C. Series is specifically called Sub-study of enhanced radiation belt



Full-scale mockup of Boeing X-20 Dyna-Soar, displayed at Air Force Area, now located in Las Vegas (see p. 17), is 35 ft. long, 33 ft. wide and 6 ft. high. Actual orbital space vehicle will weigh 18,000 lb. and carry one astronaut. Re-entry heating may rise as high as 6,000°; concentrated on the flat underside, wing leading edges and nose.

X-20 Features Unique Heat-Resistant Design

Construction techniques and block joint scheme of the X-20 are designed to provide radiation-cooling of the vehicle during reentry. Non-cup (shown, left) is of composite material and a heat-resistant radiation cooling duct is fitted over the forward windshield. It remains in position until after reentry is completed, then is jettisoned to allow the pilot to see the horizon. Wing leading edge will be "shingled" (shown, right) to help overcome temperature problems. Note use of flexible populating material in the spars of the wing leading edge to maintain structural integrity of the wing. Trailing edge of the wing and stabilizer are blank, with the rubber fueling edge also within approximately four inches thick. X-20 is complete vehicle.



U.S. Topside Sounder Delayed

Los Angeles—Launch of the Scout-borne S-40 topside sounder, originally scheduled for late this year, has been delayed to give engineers an opportunity to switch to a more reliable constant type of solar cell. The Nasa-Orlco team are expected to give the National Aeronautics and Space Administration satellite (AWF No. 20, 1990, or 1951) before production from the International Van Allen radiation lab (AW Sept. 17, p. 32).

From one to launch S-40 from P1. Arguably of an unaltered date in 1980 into a 1,000 km, circular orbit inclined by 57 deg. from the equator. This inclination would place the satellite into a new polar orbit.

The satellite will carry a 90 Hz. payload of six transmitters whose signals reflect off the ionosphere on an orbital frequency of 2.45, 3.7, 4.0, 5.4, 6.0, and 6.77 MHz. Signals received at the satellite will then be transmitted to ground and are expected to provide a profile of the electron density of the F₂ layer of the atmosphere.

The satellite will have three dipole antennas in the plane normal to its spin axis. Each pole will be 10 ft. in length when extended. Lifetime goal of the project is one month in orbit.

National Bureau of Standards Central Radio Propagation Laboratory and Aerospace Instruments Laboratory jointly prepared the experiment, with NBS designing the experiment and AIL developing the hardware.

Canadian Satellite to Measure Electron Density of Ionosphere

By Barry Miller

Los Angeles—Canadian satellite Alouette, designed to measure distribution and seasonal variation in the electron density of the ionosphere from above its peak level of ionization was expected to be sent into a near-polar orbit by an Avco Electro-Air 8-200 carrier launched late last week. A scheduled Wednesday night launch from Ft. Aguilar, Calif., was postponed temporarily because of last-minute uncertainties about operation of the satellite descent system.

Electron density profile (electron density magnitude at varying altitudes) is expected to come from its payload, conducted by the Alouette-disseminated S-27 and a subcarrier Alouette-Air-540-will have two effects in each direction: to ionosphere, radio communications, detection of ICBM warheads and missile debris, communication with re-entering space vehicles and other transmitters.

Both the Canadian satellite, which was a joint Canadian/National Aeronautics and Space Administration, and the Avco 8-200, are part of a joint Canadian/National Aeronautics and Space Administration program to launch a series of topside sounders—experiments which attempt to explore the ionosphere from above its peak, to obtain F₂ layer, rather than from orbit of ionosphere type ground-based radar probes commonly employed to date. The F₂ layer extends from about 180 to 600 in altitude.

NASA has scheduled only single S-27 and S-40 shots, but two flight

models plus a flight-qualified prototype of each must have been built and be possible to launch in the event of launch failure at the Canadian launch site. Canada (launched in 1970) in NASA's topside sounder program over three years ago, pioneered by its own more frequent experiments in long-range, low-altitude, low-frequency, ionosphere-sounding, Alouette-Air-540-will have two effects in each direction: to ionosphere, radio communications, detection of ICBM warheads and missile debris, communication with re-entering space vehicles and other transmitters.

The topside sounder (Alouette-Air-540) will be launched on a Scout (AWF No. 12, 1985, p. 237) but the advantage of carrying low frequency payloads at a low altitude orbit is that it can be launched from a low altitude orbit, thus avoiding the high frequency (HF) radio path on the ground. The Alouette-Air-540 will have a lower sampling rate—once every 15 sec—as a low frequency.

Under the joint arrangement with NASA, Canada's Alouette-Air-540 will be launched from the Canadian launch site, while the Alouette-Air-540 will be launched from the Canadian launch site. The Alouette-Air-540 will be launched from the Canadian launch site, while the Alouette-Air-540 will be launched from the Canadian launch site.

option. In addition, Canada's defense research board built three telemetry stations in Canada and two other stations, needed for the S-27 experiments, were operated by Great Britain in Singapore and in the South Atlantic.

Both Alouette and S-40 were scheduled to be placed in orbit, but the Alouette, 400-kg, orbit altitude orbit around 300 deg from the equator. The S-40 will be placed in orbit around 300 deg from the equator.

Two sounders are designed to supplement, rather than duplicate, one another. Alouette was intended to concentrate on the polar and seasonal poles while S-40's measurements will be along the 75 deg. orbit.

Spreadsheet Canada: Alouette, a small, high-flying, Canadian launch, was equipped with a nonreusable rocket-propelled ionosphere to broadcast 130 transmitted pulses at the rate of 67 pulses per second on a carrier frequency of 1.6 to 11.5 MHz except at a 1 sec. rate. Time-derived returns, as a function of the sounding frequency, were to be transmitted back to earth.

Sounders on the way: The topside sounders, each ionosphere sounding station in Canada, three of them built specially for the S-27 sounder, and other stations outside Canada plus a beam of signals at the top of the ionosphere using more powerful systems of the recent frequency transmitter carried on the satellite. Thus, ionosphere data to some profiles from above and below the ionosphere.

Alouette-Air-540, a light transmitter with a second launch transmitter suitable on command could be used to cover the primary orbit. The satellite also carried a 1.35- to 1.57-MHz channel, and a 1.35- to 1.57-MHz channel, and a 1.35- to 1.57-MHz channel. It was designed for a minimum lifetime of one year.

S-40 will employ a fixed frequency sounding system, transmitting its high frequency (HF) radio path on the ground. The Alouette-Air-540 will have a lower sampling rate—once every 15 sec—as a low frequency.

The Alouette shot is the first international topside sounder designed and built by a nation other than the U.S. or Russia.

Alouette was to carry three additional experiments besides the sounder. These are to measure plasma noise from space and radio noise produced by the ionosphere, and to observe the ionosphere from a low altitude orbit.

Lockheed Deadlocked With IAM

Los Angeles—Lockheed Aircraft Corp. last week was deadlocked with the International Union of Machinists on whether to allow its employees to vote for a new union, the Machinists of the company's Defense Group in Baltimore, returned to their jobs Thursday. They returned work after Washington obtained a court injunction blocking the 1957 of the National Labor Relations Board (NLRB) to force Lockheed to resume its pact with the union.

Strike, involving 1,500 maintenance and production workers, stemmed from a dispute over the status of about 40 maintenance workers from the Air Force and Electronics plants, who had been transferred into a single unit, from IBM transferred the men—members of Local 130 of the International Union of Electrical, Radio and Machine Workers of America—would cause some in jurisdiction. Westinghouse and the matter was for the National Labor Relations Board to decide.

Union spokesmen, meanwhile, were angry that Lockheed had not agreed to a new contract when the IAM denied its go through with a strike scheduled Sept. 24. The company, they said, hoped to exploit the actual public inquiry against interfering with the election of a new union.

About 15,000 Lockheed workers represented by the IAM are continuing to work here under their previous contract with the company. However, they are on strike on the day 10,000 workers, their union said last week, that IAM would schedule another strike vote daily if the question of the union ship was not resolved.

United Auto Workers and National Aeronautics and Space Administration Sept. 24 on a four-year contract which was to be settled yesterday by the union's membership. Under its terms, members of the IAM's bargaining unit will vote Oct. 1 on a union ship.

NASA contract also provides for a wage increase of 5 to 8 cents per hour for the first year, an increase of 5 to 7 cents per hour the second year, and 6 to 11 cents as a low frequency.

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9 cents per hour for the third year. Meanwhile, in East Coast aerospace firm developments, Westinghouse was scheduled to start this week, but the Machinists of the company's Defense Group in Baltimore, returned to their jobs Thursday. They returned work after Washington obtained a court injunction blocking the 1957 of the National Labor Relations Board (NLRB) to force Lockheed to resume its pact with the union.

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NASA School Grants

Washington—Five students will share \$6.4 million in National Aeronautics and Space Administration grants to build laboratories to be devoted to space science research. Grants are the first by NASA for facilities construction under the agency's growth and innovation program (AW July 9, p. 197).

Schools receiving facilities grants are University of California at Berkeley, \$1.9 million; University of Chicago, \$1.7 million; Southern Polytechnic Institute, \$1.5 million; State University of Iowa, \$600,000 and Stanford \$510,000.

News Digest

First of Lockheed Cargo STOL transport Air Transporter cargo has been delivered to Sweden.

Model 2 spacecraft was expected to be \$164,717 in, from the sixth at 2 y in orbit. The spacecraft, weighing 1,577 lb, is at a constant in orbit, up, up, up from the objectives of the sun on its journey toward an association with the planet Venus. Scientific and engineering instruments data arriving at Jet Propulsion Laboratory through late last week indicated that all spacecraft systems are operating satisfactorily.

Control Avionics Systems, maker of Northern Hudson and Navalair, last week bought two BAC 111s.

Witness of Air Force 1963, Fighter Weapons Meet at Nellis AFB, Nev., said Capt. Robert E. Telford, 479th Tactical Fighter Wing, Coast AFB, Calif., Telford won \$9,816 out of a possible \$24,000 points during the July 4-5-6 at a field of 17 F-105s, F-106s.

Lockheed Aircraft Corp. has acquired an 80-acre site adjacent to the University of Alabama Research Institute in Huntsville, Ala. for a building to house Lockheed personnel working with NASA officials on joint space projects.

UMAF has named Col. Gay M. Townsend, first military pilot to fly the B-1, B-2 and B-3 bombers, to head the team of contractors and service technicians to build the North American XB-70 after its scheduled delivery later this year. At Walnut, North American chief pilot, is scheduled to fly the XB-70 first, followed by USAF Lt. Col. Robert E. Telford, USAF XB-70 test pilot, and Maj. F. H. Folsom.

Boeing built an Army-Rearview Hawk, low-level anti-aircraft missile from the U.S.

Foreign Airlines Hail New U.S. Attitude

White House study urges more liberal approach; secrecy arouses dissension among American carriers.

By L. L. Doty

London-Foreign flag carriers are elated over the philosophy contained in current White House study on international air transportation, first disclosed by Aviation Week (Sept. 10, p. 57). Details of the study, which will be the basis of a revised U.S. policy in that field, are likely to amplify that elation. Unfortunately, misfeasance is that the White House will follow its normal routine and withhold the full text of the study. The informal secrecy attached to the work has already stirred some industry dissension, with a major U.S. carrier charging that a possible competitor has seen the study while it has not.

Final recommendations to the President on the course the U.S. should follow in establishing an international air transport policy will be made by a White House steering committee, headed by N. E. Blahley, Federal Aviation Agency administrator. These recommendations will be based on the proposals developed in the study, which was conducted by private consulting firms. Whether the steering committee will apply all the details of the study in formulating a proposed policy cannot yet be determined.

Basic Measures

However, there are some of the basic measures the study recommends as guidelines in developing U.S. international air transport policies:

- **Economic should serve as the sole criterion in the operation of international air services by U.S. carriers.** All decisions on the foreign air routes, airports and traffic rights should be based on economic rationality.
- **U.S. carriers should concentrate on high-density markets.** This recommendation is based on the theory that U.S. airlines are specialists in the production of mass transportation, but relatively weak in performing the high-potential type of service needed in developing low-density traffic markets.
- **Lower fares should be adopted in high-density areas, particularly in the North Atlantic market.** The study says that high fares restrain the expansion of air traffic, limit airfreight operations and force local factors down ward, which, in turn, cause carriers to shift away from competition with potential firms. These recommendations apply to carriers with the pattern of fare structure the International Air Transport Association traffic conference is seeking to develop at its meeting in Chandler, Ariz. (AW Sept. 23, p. 13)

- **Current and the government should encourage the wide dialogue between carriers and passenger services.**
- **International air transportation should not be considered as a factor in U.S. foreign affairs, except in cases where U.S. foreign carriers' operations may play a part.**
- **U.S. should avoid adoption of any principles of protectionism.** U.S. policy should be based on economic liberality and an attempt should be made to enter into agreements on schedules of foreign flag competition.
- **Determination of low money U.S. carriers should serve a given foreign port should start with the Civil Aeronautics Board.** The study recommends that the adoption of "multiple designations" or "charters institutions" on one route or areas of routes should be decided on the merits of each case.

The study also says that the parties, including both sides, should be treated equally in the U.S. drop its attempts to impose capacity restrictions on air carriers serving U.S. ports. The trend toward pooling and mergers, coupled with the rapid growth of potential income in Europe, has given other European carriers confidence that they can now compete with U.S. airlines on a broader of the North Atlantic, where they have long been protected against U.S. competitive power was necessary.

On the other hand, U.S. airlines for the past few years have held that they have been in financial jeopardy because of a steady loss of traffic to foreign competitors in such areas as the North Atlantic and South America, and have sought some protection against these attacks.

The White House study not only says that down the path protection is harmful, but recommends that the U.S. no longer consider those of the market

as a factor in the development of U.S. international air transportation and proposed that expansion of the international travel market serve as the chief goal of U.S. airlines.

The White House study also calls for at least a portion of the recommendations included in a CAB staff study of North Atlantic routes (AW Sept. 23, p. 18), which most foreign flag carriers found agreeable.

The Board staff study recommended that U.S. carriers serving the North Atlantic focus their attention on such high-density, traffic markets as London, Frankfurt, Paris and Rome. That committee said the White House study's advice that U.S. airlines should operate as specialists in high capacity is unrealistic.

The White House study is, of course, silent as to how these routes should be divided among U.S. airlines. The Board staff study said that Pan American serves London and Frankfurt and that TWA, some Pan and Rome.

Fare Reduction Suggestion

The White House study's suggestion that fares be reduced in high-density markets will also affect the airlines, which have been losing flag carriers. Smaller airlines will stand against that proposal, but at least low-fare foreign airlines will not.

Findings in the study is the suggestion that international air transportation is not as important to U.S. foreign policy as many airline and government officials have led themselves to believe. The suggestion that international air transportation be treated primarily as an economic enterprise may be interpreted by some—who have consistently maintained that the airlines are flag carriers in the past years of the philosophy regarding the industry to a lower status than it deserves.

If that is true, U.S. international carriers will be at a disadvantage in competition with foreign flag carriers, which have the full support and backing of their governments, and which are viewed as a prestige symbol of the nations they represent.

Essentially, the White House study recommends that U.S. airlines take full advantage of their basic capabilities in competing with foreign flag airlines. These include the ability to operate efficiently at low costs, provide mass transportation, high-density markets as a wide outlet and produce a good product at a low charge to the consumer.

Giant B-62 Transport Rolled Out

Mooney-Swift aircraft designer Terry Hughes rolled out his giant B-62 jet airliner last week for inspection by Nikola Khrushchev and other top Communist officials and turned it over to Aeroflot for flight testing. The B-62 is probably the largest jet powered airliner in the world, rivaling the Boeing T-141 international transport, British VC-10 and largest version of the Boeing 707.

The B-62 has a fuselage 358 ft. long, carrying 162 passengers seated in a moderately-crook wing and a T-shaped empennage, with the horizontal stabilizer mounted atop the vertical fin. One driving AW No. 78, p. 41. It has 12,000-hp thrust engines installed in two nacelles on each side of the rear fuselage. Engines were designed by N. D. Kuznetsov, who also designed some of the turbojets engine on only B-62 transport. The B-62 is designed for a 5,000 mph (Mach 2.6) cruise speed over a Mooney New York transport can with standard fuel reserves.

The B-62 is Russia's first transport design with all-weather engines, although the Russian Ministry of Aviation (AW July 17, 1967, p. 63) had approved previously with design features that would make it the leading all-weather version of the T-141 without range or thrust.

ATA Appeals to Press to Reduce 'False Alarms' on Airline Strikes

By Robert H. Cook

Washington—Air Transport Association officials are appealing to the press for a better understanding of the Railway Labor Act as it affects the industry, the release of "false alarms" strike threats which ATA claims take a heavy toll of industry revenues every year.

ATA, which represents U.S. airlines, contends that press, radio and television news agencies have issued "warning powers" of actions in their negotiations with the airlines.

The group has completed a study of the "warning powers" techniques which it said have been used by the Transport Workers Union against American Airlines over a period of 35 years. Part of the study includes a series of clips taken from New York and radio newspapers which ATA feels characterize the ability of a union to keep an airline under "constant pressure" by creating the impression that a strike is imminent.

Examples cited by the ATA include only one case in which TWA, but the association and such "scare psychology" has been used with equal effect by the Air Line Pilots Association and the Flight Engineers International Association. ATA feels that the use of this study in all airline public relations negotiations, plus at least 150 live columnar and reporter in all news media. Along with the study report is a memorandum ordering the four national organizations to take action to reduce the "warning powers" of the ATA, as of their own choice, through their negotiations of the Railway Labor Act, the Department of Labor and the White House, has concluded that problems and their high potential public relations impact could be solved by the press and the industry.

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with the responsibility for their own losses" a TWA official said.

Legal representation that at least one major airline carrier has used the Railway Labor Act as a weapon against the union, rather than as a collective bargaining device, was considered in a U.S. District Court refusal to grant Pan American World Airways an injunction against TWA last August, the union said.

Judge John P. DeLoach, Jr., argued the injunction on grounds that the union has "failed to perform its obligation" under the terms of the Railway Labor Act. He complained that the Act is "not in negotiation" with potential future strikes, and that the union has not been able to make optional individuals of the collective bargaining process at the choice of either party.

The parties must negotiate reasonably with reference to their positions and their commitment to the status of change. Continuity at least past a party to negotiation with an obligation can and should appeal for mediation and for emergency relief. But no party can plan its negotiation so as to anticipate mediation and emergency steps on the road to agreement. It is not in the public interest if it does so, an expansion will implement its technique of negotiation," Judge DeLoach said.

Labor Disputes Settled

Washington—Trans World Airlines settled its crew contract dispute with the union last week with the Flight Engineers International Association and Southern Airways began settling pilots after a contract agreement reached this month.

Terms of the TWA contract with the Flight Engineers International Association were not disclosed, pending a satisfactory by union members but they are understood to follow the recommendations of the Professional Consultants for Three-way crew operation of the industry, with a pilot-qualified engineer position. With a crew of about 35 per aircraft, plus a minimum reserve crew of 170,000 for each F4A model serving in take or landing operations (AW Sept. 23, p. 41).

Southern, which stopped bargaining sessions with the Air Line Pilots Association last week from the Civil Aeronautics Board (AW Sept. 23, p. 14), is based at 150 airlines in the industry. Southern they held at the time of the union and agreed to ground crew and working conditions provisions under the terms offered prior to the strike. Non-strike pilots, including pilots who will be placed in the bottom of the ALPA seniority list. Training and check-out for the entering pilots is expected to be completed by Dec. 1.

Board Urges Permanent Adoption Of No-Show Penalties by Airlines

Washington—Permanent adoption of the airlines' no-show plan has been urged by the Civil Aeronautics Board after a detailed analysis of the experiment's first three months of operation (AW July 8, p. 28).

Initial results of the plan, which assigns penalties ranging from \$75 to \$400 against passengers failing to appear for flights and a like amount against airlines which fail to provide a seat to holders of reservations, has caused the Board to advise airlines that they should approve a second year of the plan beyond the present expiration date of Oct. 31.

The Board, while emphasizing that the airlines still need to improve reservation procedures and to further expand its two direct responsibilities to meet reservation obligations, pointed out that no-shows in the May, June and July period dropped from 9.8 to 6.9%. Total seats lost through no-shows decreased in the same least affected by the Eastern strike and continued cost control for the balance of the industry.

Passenger no-shows under the plan amounted to little more than 0.1% of all passenger seats in the airlines in the three-month period.

Overall results of administering the plan were more than net, but total collection, so that passengers are "temporarily given more attention to their reservations" and that airlines are "temporarily given more attention to their reservations," the Board said.

The CAB analysis showed that the cost to the airlines for no-shows under the plan dropped from \$122,837 in May to \$82,110 by the end of July.

Overall penalty payments totaling \$50,182 were made in July to 1,476 passengers, as compared with \$15,918 paid out to 1,682 passengers for this purpose in May. An additional \$12,693 was refunded in July to 1,526 no-show passengers who offered valid reasons for missing their flights. "The results of this refund were excellent for the airlines," said the plan, permitting a 30-min extension beyond the scheduled flight departure for ticket holders deferred en route to the airport.

The Board noted that the airlines needed a total of 16,919 no-show bids totaling \$318,647 in July, but only succeeded in collecting \$8,428. The CAB said that it has received more complaints about these bids, many of which appeared "irregular."

This would seem to amount for the low percentage of bid collections by airlines, so that any comparison between the current actual and collections and

then bids cannot be considered a reliable indicator of the success or failure of the entire no-show plan, the Board said.

Debiting all administrative expenses plus refunds to no-show passengers and payments to no-showed tickets, the airlines had a net profit of \$19,569 from the plan in July, as compared to CAB figures. Board statisticians added that Eastern Air Lines did not report June and July losses because it claims that they were subtracted on incomplete report because of the strike.

U.S. Probes Ditching Of Tiger Constellation

Washington—Civil Aeronautics Board last week began an investigation of the ditching of a Flight Tiger Line Constellation at Charlotte, N.C., last Sept. 25 approximately 140 mi west of the Irish coast. Of the 78 persons aboard, 46 were rescued.

Ditching occurred at 6:11 p.m. EDT at 34.5 deg. north latitude and 74.9 deg. west longitude, after loss of three engines. The aircraft was operating as a military charter flight out of McGhee Airfield carrying military personnel and their dependents to Frankfurt, Germany. It departed the airfield, reportedly after refueling, at 4:40 p.m.

According to the CAB, the plane lost the use of No. 3 engine, which was inboard, at 1:15, hours later. Engine No. 1 was then lost and left-hand and right-hand "third engines" was lost. CAB said.

With the loss of the first engine, the plane ditched at about 30 minutes before it was scheduled to arrive at Charlotte. It did not stop before to ditch. At the time, south of Gulf Stream were reported with waves up to 41 ft. high.

Three other flights in the area, a Military Constellation, a C-119 (Douglas DC-6A) and a B-57C (Douglas DC-7) had been diverted to report the dived Flight Tiger flight. When it ditched, the MATS C-119 had sufficient fuel to reach the area for 5 hr in the event of a ditching. The CAB said.

CAB and the Federal Aviation Authority conducted a on-board inspection of Flight Tiger during October and found the carrier capable of maintaining a safe operation. CAB's terrain and capability survey team actually conducted an inspection of the airline and found it to be satisfactory.

CAB Air Safety Investigator B. R. Allen has been placed in charge of the

accident investigation. He will be assisted by John McWhorter of the CAB in system factors and investigation of crew and passengers. CAB investigator Richard C. Doyle will analyze the air factor aspects, including emergency evacuation procedures. CAB and the Coast Guard are expected to have a final report of 15,700 ft.

The ditching was the second Flight Tiger accident this year. On May 16, a Lockheed 1049H disappeared in the Pacific with 107 persons aboard during a night flight between Saigon and Manila.

CAB Asks Retention Of Low Cargo Rates

Washington—U.S. the carrier attending the International Air Transport Association conference in Chicago, Ill. (AW Sept. 24, p. 43) has asked the Civil Aeronautics Board to retain low cargo rates and expand the 17-day, maximum time to all airlines.

In a letter addressed to 24 U.S. air carriers, CAB Chairman Allen S. Boyd, newly elected in September, issued the request. He said that the airlines, after attending the conference, were in favor of the low rates.

• Present cargo rates should be retained and no reduction should be given to airlines which would result in the loss of the low rates of general cargo rates. Boyd identified that the lower rates introduced last year had failed to develop the cargo market nationally and had resulted in a reduction of foreign cargo rates.

Boyd said that the airlines had failed to be considered as an independent of the basic aviation approach. The Board, he said, found a definite loss of rates at approximately higher collection rates.

• Specific commodity rates should be adopted only when such rates can be applied to promote new business or attract new types of traffic.

Boyd said that the CAB on the North Atlantic has been found to be successful by the CAB and he is helping to expand the North Atlantic market. Boyd recommended a continuation of these rates and urged the expansion of such rates to other areas.

• CAB is opposed to the group fee program that no refunds may be made within 30 days prior to flight departure. Boyd said the CAB feels that departure of the last remaining fare is unfair, "hard" and suggested that a less strict financial penalty would effectively deter cancellations.

• Extension of the 15-day 17-day refund period to all airlines. Boyd was recommended. Boyd said the Board had "no fixed opinion" as to the number of days prior to flight departure that the Board will support a period of approximately three weeks.

Eastern Implements Sales Group Change

By James R. Ashlock

New York—Elimination of geographic and expansion in favor of a single sales arrangement, with direct authority between home office and field offices, has been adopted by Eastern Air Lines, according to plans going into effect this week.

"This has meant a complete change within our sales organization," said Malcolm A. MacIntyre, president of Eastern, in announcing the move.

The move, an outgrowth of Eastern's reorganization through the selection of new sales and procedures, Eastern has already put in personnel force to 14,000 compared with 17,000 prior to the strike.

The airline has also reduced service to certain low revenue points, providing only one or two flights daily where it flew one or five before the strike.

This resulted mainly from the retirement of its 19 H-100 twin-engine aircraft. "Consequently, we've already sold 32 of those airplanes."

To make up for losses, we've increased the utilization of our Constellation fleet to what it was before the strike," he added. "But that's not all."

MacIntyre said he believes the answer to the airline's financial problems rests in providing better service, reducing costs and also changing up market research aimed at attracting new business.

There is a need, he feels, for more customer acquisition as well as the old way of selling. He believes that the airline should be able to sell more seats.

MacIntyre said he did not believe the overcapacity problem could be solved by a mutual agreement among carriers to restrict flight schedules.

"I think overcapacity is an illusion so much as that a carrier would be practical, he said. But I believe elimination of overcapacity would be a better approach."

Eastern's overcapacity, and its subsequent reduction of personnel, are not calculated toward the carrier's proposed merger with American Airlines, MacIntyre said. But it is a comparison given to recent changes in American's sales force (AW Sept. 24, p. 43), he added.

"We did eliminate personnel of what we are doing," he said, "and there was no loss."

MacIntyre said he was still optimistic of future approval of the Eastern Airlines merger. The transaction will be seen in a new Civil Aeronautics Board decision this week on Eastern's application for the CAB in late October.

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the end of the year, and I hope 50-55% in a year or so."

He viewed any general service, MacIntyre said, Eastern is experimenting with the idea of establishing parking lots exclusively for Eastern customers, with shuttle bus service to terminals.

"I've spent one at Boston and I've seen the strike," he said, "and I've been back there and we must expand it soon."

MacIntyre said the "business" of the airline should not be considered as a business, but as a service of people and procedures. Eastern has already put in personnel force to 14,000 compared with 17,000 prior to the strike.

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later, and a final decision before year's end.

Reorganization of sales and services will not bring any major changes of figures at Eastern's top level beyond those that have already occurred, MacIntyre said. William L. MacIntyre, Jr., former vice president of sales and operations, resigned Sept. 1 (AW Sept. 1, p. 38). Maurice B. Worthington, former vice president and general sales manager who recently became a consultant to MacIntyre, has plans to leave Eastern.

The new organization finds sales and customer services combined into a single function. Coupled with this is an expansion of Eastern's commercial activities, both luxury business and direct service sales managers being shifted to positions of commodity sales.

Over all directors of the new organization is Robert L. Turner, with the title of senior vice president and general manager. He will be responsible for the entire operation.

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Slick Plans Door-to-Door Air Cargo System; Resumes Common Carriage

New York-Slick Corp. is proposing a limited expansion outside its current field of just air-to-air "self-sufficient" plans for supporting truck movements in its air-truck field plus new below the Civil Aeronautics Board or its entry into common carriage in a combined air-truck operation.

A year ago, Slick acquired the Thine Shale Co. with an aerial cargo fleet of about 54 million. Now it has reached preliminary agreement with the Metropolitan Corp. to acquire through stock exchange, the Peabody Machinery Co. of Summit, N. J., a Metro-Martin division. The latter company is growing about 540 million annually.

Both Thine Shale and Peabody Machinery have a large fleet of cargo planes and good management. D. W. Rindell, Slick Corp. president, said, "We are simply acquiring another business," he said, "that will contribute cargo to our company. We considered a long time ago that we were going to subsume air cargo, so we decided to subsume aviation."

Slick will return to common carriage today after a six-year absence with supervision of its combined military-commercial cargo operation.

The system will mean replacement of a Douglas DC-4 on one of its six Navy contracts, versus with a Lockheed T-43H Super Constellation.

By doubling the 70,000 lb cargo capacity of the DC-4, Slick will be able to sell 16,000 lb of cargo space on the entire strong, strong, Hartford, New York (Hawthorn), Indianapolis, Dallas-Ft. Worth and San Francisco, and still provide 10,000 lb for the military. A daily flight each day is planned.

Rindell said the system, if successful, could be extended to other military routes to serve Chicago, St. Louis and Los Angeles. He was saying when all four of Slick's Constellation CL-44s are delivered, trucking service in common carriage is expected to begin. Slick's two CL-44s now in service are handling military charters in the Far East.

Navy favors the petromotor system.

Slick Turbofan Order

Slick Corp. is negotiating with the Boeing Co. and Douglas Aircraft Co. on an order for two turboprop-powered cargo transporters—either Boeing 707-300C or Douglas DC-57C. The order is the subject of an ongoing debate on a government loan for cargo aircraft will be a major factor in a proposed on the order, but Slick hopes to make a decision in 30 days.

Rindell said, common is often the product of better service at lower cost to the military.

To develop common carriage, Rindell is seeking to break the air cargo dilemma by creating an air-truck system providing door-to-door service on a through bill of lading. The air cargo, he said, has faced the problem of having too little volume to permit recharging costs and not being able to attract sufficient non-freighting cargo.

With a new non-freighting operation in mind, Slick has filed with CAB a proposal that would offer a second movement delivery on its air-truck, plus at rates no less than first-class rates. This, in effect, creates common air-truck rates, which now provide such incentives as a five-day deferred service basis, into a two-day cycle.

"I'd like to see an air service contract that is a bridge between an air right, trucking, company," Rindell said. "Our future is in the closer serv-

ice than the major airlines and their packaged freight, but perhaps more competitive with surface transport."

Slick is proposing a joint venture, payable with one or two truck lines in each city, on an assigned common carriage route, Rindell said. Nothing is less than a formal contract of a truck line with Slick, Rindell believes, but the one is a lower price point.

Standardized transportation is an essential part of the plan, Rindell said, and Slick is working with several manufacturers and truckers on this problem. To provide a low cost service requires that the customer do his own packaging then holding down, handling expense on the part of the carrier.

Handling on the air-truck to take into air to get right to the customer, Rindell said. The result has been to drive the industry, the lowest cost cargo handling, partially out of the low-cost/medium freight business.

The contract, Rindell said, is, in effect, a lower which can be picked up at the shipper's door and delivered to the consignee the same way and with the same concept that the industry can handle a deeper-loaded box car.

Hughes Ordered to Appear Oct. 29

New York—Howard Hughes has been ordered to appear in the Los Angeles U. S. District Court on Oct. 29 to face his deposition taken in the \$115-million Lockheed case.

Judge Charles M. Metzner said he would permit Hughes to appear for further delay on Oct. 22. A spokesman for the Hughes-Hughes attorney here, was unable to say whether Hughes would seek for the delay.

In another development, Judge Metzner, a sympathetic for Dorn, served TWA a subpoena to appear in court in December with a subpoena while he was flying over New York City at 8:30 p.m. Sept. 19 showed an American Airlines Boston-Detroit flight.

The subpoena calls for an answer within 20 days after service to Hughes' TWA's \$360-million counterclaim against TWA. Dorn was issued a subpoena to appear in court for his role in TWA's jet financing, which he served as one of three young partners from Dec. 1960, to Jan. 1962 (AWF 79, p. 67). He is expected to ask that the subpoena be dissolved because it was served "over" a state other than "in" a state having jurisdiction over the suit.

In Judge Metzner's Sept. 21 ruling on the Hughes application, he deferred ruling on the TWA charge that Dorn's subpoenaed data Hughes to accept the subpoena in his behalf was a strategy

(AWF Sept. 18, p. 70). At a hearing on Sept. 18, Dorn told the court that even if Hughes did not sign the authorization himself, it was nonetheless binding.

On Hughes' motion, Judge Metzner's Sept. 21 ruling was:

• **Fourth subpoena against Hughes TWA.** The Special Master, appointed by the court to supervise the deposition, ruled Sept. 19 that Dorn's authorization to accept the subpoena for Hughes was valid, regardless of TWA's alleged claim. He gave Hughes until Sept. 21 to reject this interpretation. If Hughes fails to deny the validity of the subpoena after Sept. 21, the Special Master and he would enter a \$115-million judgment against Hughes TWA and state in favor of TWA's claim that the record Metzner said that since he hadn't heard from Hughes in the country, he assumed Hughes had accepted the interpretation.

• **Pretrial conference to define the facts and issues of the case.** Judge Metzner said he would allow the parties to have a pretrial conference in an effort to expedite the case. Dorn has taken depositions from three TWA witnesses over a period from last January to Sept. 21 with 30 more witnesses to be taken. The Special Master ordered on Sept. 15, in response to the TWA's request— which can nearly 7,000 pages—that he will deny the "ultimate facts" were that TWA was using to establish its allegations.

Amery Rejects U.K. Route Award Appeals

By Herbert J. Coleman

London—Newport appeals against route awards granted to five British airlines for the London-Glasgow route. The awards were made by the Civil Aviation Authority (CAA) on Sept. 18, p. 12) have been accepted by Amery Minister of Transport, thus increasing competition for state-owned British European Airways.

Immediate effect was a BKA prediction that route awards would mean more flights and less hope for a decrease in fares. When the award was made, British United Airways expressed satisfaction with the results, but Caledonian Airways was sharply critical.

"It is possible that we have had to work for two years since introduction of the [Air Transport Licensing] Act and now find that the minister's decisions give us enough work for two to three months of the year. It is a complete failure and the worst decision made by the CAA."

The minister confirmed these notes. • **British United Airways—Nine routes** operating at London-Peterhead, twice daily, Aberdeen, Glasgow, Manchester, Belfast, Newcastle, Palma and Lisbon-Madrid. Licenses for service between London and Zurich was revoked.

• **Caledonian Airways—Six routes** connecting London to Glasgow, Edinburgh, Belfast, Dublin, Copenhagen via Stockholm and Liverpool to Dublin. Licenses for service between London and Glasgow were revoked, and Caledonian's right to operate a service between London and Newcastle, London and Liverpool and Manchester and Dublin was refused.

Amery acted after inspecting recommendations of the appeals committee on the London-Glasgow route. He said that the award was made to serve London-Venice to improve the air at Victoria.

If a larger airplane, such as a Boeing 707, is used, the trip will cost about two pence.

The London-Venice route is directly competitive with BEA but Amery ruled that scope for growth of tourist traffic in large aircraft is just a narrow service by Caledonian.

Amery's decision was largely the result of the London-Glasgow ruling, in which Caledonian had plans for inauguration of high density, no-stop service for businessmen making the round trip in a single day.

Under the Amery ruling, Caledonian gets seven flights a week, on one round trip per day. The airline will then compete with 97 flights weekly offered by BEA, and its main objection

is to the limitation in frequency BEA can exercise its frequency, if required.

Because of the limitation, Caledonian will be forced to keep an eye on the Glasgow side of the day, or to make it to avoid a loss in long utilization time ago, with all the attendant operational complications this will involve.

At present, the company is relying on the potential of the jet-airline world's service and the possibility that it will ask for consolidation of the license, although officials refuse to consider the British of Caledonian's flight's reaction, application also has been made that the airline will merge its domestic and European service with British United and continue the service with its new camp with British Overseas Airways Corp. on North Atlantic service.

Reason for the minister's revocation of the London-Zurich license was his reluctance to ask the Swiss government to accept a third British operator on the route. The case was now served by both BEA and BEA, Swiss, operating applied to London-Geneva service, was a private BEA route.

Meanwhile, British United last week said at subsidiary companies, Jersey Airlines and Silver City Airways will operate a domestic service in the United Kingdom, with routes connecting with the Continent, under the new name of British United (C.I.) Airways (C.I. stands for Caledonian Islands).

Two airlines were required earlier this year by British United, Lord Selkirk's country division was integrated

with British United's Channel Air Bridge under the name of British United Air Ferries.

BUA officials said three new routes are being planned, and applications for approval will be made soon to the Air Transport Licensing Board. They are London to Amsterdam, London-Glasgow to Blackpool, the British vacation center, and Corvallis to Dublin.

Current British United (C.I.) Airways domestic routes into the Channel Islands with London, Bristol, Birmingham, Southampton, Manchester, Blackpool, Dublin, Cork, Glasgow, Edinburgh, Coventry, Exeter and Portsmouth. Isle of Man connections are with Belfast, Birmingham, Blackpool, Glasgow, Edinburgh, London, Newcastle, Leeds, Dublin and Belfast.

Continental services connect the Channel Islands with Paris, Darnley, St. Vincent, Geneva and Amsterdam. London-Glasgow with Belfast, Exeter with Paris, Birmingham with Belfast and Paris, Southampton with Belfast, Newcastle with Amsterdam and Darnley, and Blackpool with Glasgow.

New flight schedule from Belfast Page Diet Hedges, plus two more on Oct. 14 Douglas DC-8, and two de Havilland Hercules. Bristol 1700, operating in the north of England will be withdrawn from service.

British United (C.I.) Airways will be headquartered in the Jersey Islands, under direction of M. L. Thomas, founder of Jersey Airlines. R. V. Baker, former director of Silver City, will be responsible for all activities outside the Channel Islands.



Trident Flies to Dublin

First flight of the de Havilland Trident through transport outside the United Kingdom was made to Dublin Airport, where a group of about 2000 people in the usual guard of honor of International Air Transport Association (IATA) were on hand to greet the new jet. The flight was made by British United Airways, and the aircraft was a de Havilland Trident 1A.

AIRLINE OBSERVER

► Watch for a new move by the U.S. to sign with Iceland a bilateral air transport agreement which will apply Bermuda principles. Previous agreement between the two countries is patterned after the original Chicago Convention format and makes no provision for considerations on fares and taxes. U.S. has similar agreements with Iceland and Czechoslovakia. State Department feels that incorporation of Bermuda principles in agreement with Iceland will be a major step toward bringing fare of Icelandic Airlines up to levels of International Air Transport Association. Both Air League and Graciosa Airways Airlines are members of IATA.

► Local service airlines flew 161.2 million revenue passenger miles in August, a 24.5% increase over the same month last year. Load factor for the month was 49.7 compared to 45.2% in August, 1961. For the first eight months of 1962, revenue passenger miles rose 29.9%, load factor for the period was 42.7% as contrasted to 41.6% in the same eight-month period of 1961.

► British European Airlines feels that it may be successfully penetrating the auto travel market. Recent traffic figures indicate that BEA's air tourist routes were all within Britain. London-Glasgow total of 361,000 passengers was the top revenue producer last year and exceeded that of the airline's London-Paris route.

► Time-between-overhaul (TBO) for Rolls-Royce Type turbo-prop engines on Canadian CL-44 all-cargo aircraft has been increased to 1,200 hr. Time operation except TBO to reach 2,000 hr. by early 1963.

► French aircraft industry officials continue to grapple about use of a Douglas DC-48 transport as a presidential aircraft. Recent trip to West Germany by President de Gaulle in his DC-48 served the old complaint. French Transport Union issued a communication claiming its use of the Douglas aircraft rather than a Sud Caravelle gives the government's indifference to French aircraft products.

► United Air Lines last month began replacing the control section buses at each gate on its Viking Viscount turbo-prop transports. Completion of project on all 47 Viscounts will require an estimated two years. United also has installed an interior telephone in the Viscounts' nose wheel well to provide improved communication between flight crew and ground services.

► Unloading of air fares a major issue at last month's International Air Transport Association general meeting (AW Sept. 17, p. 38), was brought to the attention of the recent International Civil Aviation Organization assembly in Rome with recommendations that governments take steps to ensure that published tariffs are fully observed by their national carriers.

► Negotiations of the proposed merger between Trans World Airlines and Pan American World Airlines have been slowed slightly by differences over taxes, although both parties are still deeply interested in the possibility. Recently, Pan Am (d) it came closer with the best deal in view at TWA's financial problems. But TWA's improved business through the summer, particularly on the North Atlantic, has made it ask better terms.

► Air Transport Association has advised 20,000 high school principals and guidance teachers to caution students against spending excessive time and money on special training schools for airline jobs. ATA said that airlines provide training in most jobs at no cost to the employee and that except for a few special and jobs, no special preparation is required beyond a good general education.

► Federal Aviation Agency has awarded a \$10-million contract to Texas Instruments, Inc., for 66 airport surveillance radar systems. Radar will be installed at continental and overseas USAF bases in a major step toward standardization of civil and military air traffic control systems. Total of 23 ASR systems will be installed, maintained and operated by FAA. The remainder will be partly installed by the Air Force and Texas Instruments and will be operated and maintained by the Air Force.

SHORTLINES

► Airframe overhaul time on United Air Lines Boeing 710 transports has been extended to 4,000 hr.

► Boeing Air Lines carried 40,164 passengers in August, the first time in its history it passed the 40,000 mark in a single month.

► Continental Air Lines has filed a suit with the Civil Aeronautics Board asking for a 20% rate reduction for military groups of 25 or more beginning Oct. 15.

► Delta Air Lines reported a net income of \$2.3 million for August on revenues of \$23.7 million, a 67% increase over the \$1.5 million for August, 1961.

► National Airlines, which flew 152 air sections in August due to the East em Air Lines strike, reported a net profit of \$2,345,000 for the month, compared with \$12,900 for August, 1961. Operating revenues were \$10.9 million, a \$3.8 million increase over the same month last year. August load factor was 66% compared with 55% for the previous August.

► Northwest Airlines reported a net profit of \$1.6 million for August, compared with \$1 million net earnings reported in the same period last year. Gross revenues for the period totaled \$20.5 million.

► Pacific Northern Airlines ended improved business conditions and increased tourist travel in Alaska in August for its record 24,772 passengers carried in August. The 488,582 cargo ton miles handled by the airline during the month also established a new record.

► Round-the-world travel has increased 11.7% since jet transports were introduced in 1958, 1959, according to Pan American World Airways. The carrier estimates that 50,000 persons will make the trip this year.

► YNC Airlines has increased flight schedules between downtown Cleveland and downtown Detroit to 25 departures and arrivals daily. During the first six months of 1962, passenger traffic on the route increased 35%.

► Trans World Airlines has hired CAB to appoint a special Christmas holiday fare reduction of 51% per round trip on common ground level by U.S. airlines personnel and their dependent's national origins.



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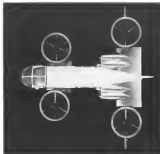


Jet-powered, ducted-flow VTOL transport will be built by Bell Aerospace Co. for Navy under contract exceeding \$18 million. Aircraft is being developed as the Navy-managed portion of the in-service VTOL program. Bell D-2127 is powered by four General Electric T16 turbojet engines (AV Apr. 9, p. 37) and will have a crew of two. Payload will be 1,200 lb. or six passengers.

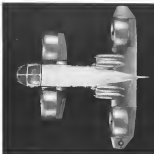
Bell Aerospace Designing Navy VTOL Transport



Bell D-2127 will have a wingspan of 79-2 ft. and will be 44 ft. long and 18-5 ft. high. Weight will be about 15,000 lb. Top speed is expected to be 350 mph. Engines are interconnected so that failure of one engine will not affect stability of the aircraft.



Ducted propeller units rotate to a vertical position to provide lift for hover and takeoff and rotate to a normal position for forward flight.

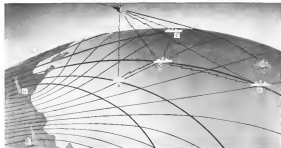


Compact has been designed around helicopter concepts to provide stability for hovering and vertical takeoff capability.



All propeller units were extended outward to prevent flow interference with forward motion. These will be used as Navy transport vehicle.





LORAN-C SYSTEM for predicting impact point of attacking missile at assumed speed(s) is shown in this staff's concept of the situation. Transmitting stations at left—two master and two slave—generate the hyperbolic surfaces whose ground traces are shown as solid lines. From these surfaces, the line tracking ships determine their positions. Actual time differences in the signal from the receiving vehicle are used to compute the position of the vehicle with respect to the base ship and therefore with respect to a fixed reference. Continuous position data is used to compute and predict the trajectory, and-by extrapolation—to predict the impact point.

Loran-C Extension Proposed for Tracking

By David A. Anderson

New York-Speer Greeneco Co. engineers are proposing an extension of the Loran-C navigation system to enable more accurate prediction of impact points for ballistic missiles and manned spacecraft.

The language conceptual and would be used to determine position of ships and aircraft in the recovery area with greater accuracy than that now available from standard dead reckoning or conventional navigation techniques. It would be combined with a monosensor tracking system to predict the trajectory of the entering vehicle. Finally, the Loran-C system would provide a common base for correlation of all the received position data.

Combination of these three techniques would enable prediction of impact points to be accurate within a few hundred feet, says Speer senior engineer Paul Mancini and Winston Tolman.

Acquisition of accurate position and velocity data for missiles and space vehicles is one of the major problems facing both men and operators of naval and service ships (AW Mar 26, p. 68). This data is needed for every point along the vehicle's flight path.

For missiles, period of exposure at launch, orbital position, velocity and impact. Most installations do not meet current requirements: proposals for future installations lack cost, cannot requirements and future requirements for the precision and accuracy of this kind of data seem almost impossible to meet.

A complicating factor is that ship-based navigation cannot be used for long-range tracking. Current land-based installations now cover only short-range targets, for example and are eventually needed for long-range missile work or for recovery of space vehicles. Added to the basic inadequacies of the subsonic system is the fact that the position of the carrying ship can not now be determined to within better than a half-mile, one way or another, and consequently all incoming data has to be modified to an assumed scenario for ship's position.

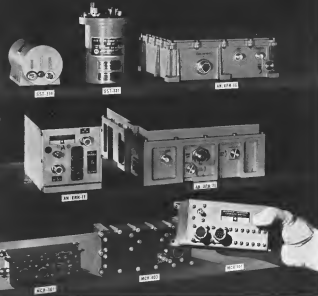
One current requirement stated by Dr. G. S. Rivers, director of the Air Force Research Office's Guided Missile Range Operations at Patrick AFB, Fla. is that ship-based instruments must locate the ship itself within 500 ft. or less.

Reality of a test evaluation of Loran-C as a ship navigation aid, made

be an independent monitoring from Pacific and Indian, last, for the Office of Naval Research, showed position error of that order of magnitude. The firm analyzed the operation of a Loran-C monitor station 550 mi from the nearest and about 900 mi from the farthest transmitter.

The results indicated that a ship in that area could expect 95% of its position fix to be within 500 ft. of the coast geographical position. Other Loran-C navigation networks, installed in the Mediterranean and Norwegian area, and on islands in the north and central Pacific Ocean, are being used by Polaris firing submarines for accurate positioning of launch sites. The idea establish the launch point for each cruise target is, using the Loran-C system. They would navigate to those points, using their ship's central navigation system (SPNS), in the event of casualties (AW Oct 23, 1961, p. 19).

Work on installation of the Loran-C system as a three-stage navigation is progressing although slowly, at the Atlantic Missile Range. Plans have been made to install systems at Cape Canaveral, Ascension and Christmas Islands and at Porton, in South Africa, but budgetary problems are the and other range instrumentation systems have de-



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level the full configuration and operation of the system.

Time correlation of events along a tracking arc of 10°, which is of importance in the reduction of all parametric data, is currently accurate to about 100 micro-seconds. Dr. Bloem suggested last March that an order-of-magnitude improvement was needed to reduce that accuracy to about 10 microseconds. Sperry says the Lorus-C system can provide synchronization of time events to 0.1 microseconds with a worst possible time error through the system of 0.5% microseconds.

Logical Development

Range operators believe the Lorus-C system represents a logical line of development for long-range, accurate meeting data acquisition. But they point out that fairly large sums of money are involved. They explained that early range requirements called for metric data that could be satisfactorily taken with inertial techniques. Ships were few and far between, and there was no pressure on to develop high speed, extremely accurate data taking instruments. As the range grew and requirements increased, it started seemed cheaper to add inertial cross-checking system with optical or celestial navigation or radio from then to do the whole range over and go to a complete long-range electronic navigational system.

But now there is more optimism among range operators that the time is ripe for a change to such a system as Lorus-C.

Lorus-C system operates in one or two systems with cover the northern and western Atlantic Ocean, the Indian Ocean, the area around the Hawaiian Islands, the north Pacific and the Asian Sea areas. They operate in the hemisphere band with a constant frequency of 100 kc. Using peak related powers between 100 and 100 kw, the ground wave range is in excess of 1,000 mi.

The Sperry proposal for a receiver and tracking train is built around four ships, each equipped with a Lorus-C receiver, a tracking receiver, an atomic clock and communication facilities for transmitting data to a central center or one of the ships.

Ship Positions

The ships would establish their position from land-based Lorus-C stations at distances up to 1,000 mi away. With these positions known, the atomic clock time could be advanced for each ship to synchronize with the time of arrival of signals from the central Lorus-C station, so that all clocks would read a common central time zone.

The receiving vehicle would carry a transmitter operating in the VHF 10-100 mc range. The proper VHF frequency would be chosen to get



Detailed mockup of Atlas F side boundary of General Dynamics/Astronautics shows top and bottom air ingresses, 1 and 2, and closure system.

Atlas F Tested on Silo Launch Platform



Atlas F undergoes dual propellant loading test at Schilling AFB, Kan. After missile begins to emerge from underground silo, with ridges that are moved by liquid nitrogen. Below, launch platform is loaded in launch position. Atlas "back out" to allow ejection is started before the missile is lowered again. Most of the ejection is propelled back into storage tanks in the silo.



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CLASS 100—Molybdenum sheet with defined, specified reproducible mechanical properties. Recommended for simple forming and bending operations where the more highly defined mechanical properties of Class 200 are not needed. Available in widths from 14 through 24 inches.

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BASIC FORMS—General Electric molybdenum and tungsten products are available in a wide variety of forms. Molybdenum density for tungsten, 97%, for moly, 95%. Other base forms of tungsten and moly can also be made: squares, rectangles, circles. Molybdenum coils section is that which can be sintered in a 12" circle. Lengths go up to 56 inches depending on cross section dimensions.



powder, wire and rod products...

METAL POWDER—Tungsten and molybdenum metal powders of 30-55 maximum particle size are listed from General Electric for all types of applications requiring the use of metals in powder form. They are produced by the hydrogen reduction of high purity compounds produced by chemical precipitation of tungsten and molybdenum compounds. Tungsten and molybdenum powders are available in a wide range of particle sizes.



Hydrogen-reduced tungsten metal powder is available in a wide range of sizes. For example, you can get it with an average particle diameter (as measured on the Fisher Sub-Sieve Sizer) of 10 microns and still the way up to 50 microns. General Electric tungsten metal powder can be made in any size range from 0.5 to 100 microns. Tungsten metal powder is available in a wide range of particle sizes. For example, you can get it with an average particle diameter (as measured on the Fisher Sub-Sieve Sizer) of 10 microns and still the way up to 50 microns. General Electric tungsten metal powder can be made in any size range from 0.5 to 100 microns. Tungsten metal powder is available in a wide range of particle sizes. For example, you can get it with an average particle diameter (as measured on the Fisher Sub-Sieve Sizer) of 10 microns and still the way up to 50 microns. General Electric tungsten metal powder can be made in any size range from 0.5 to 100 microns.



WIRE AND RODS—Tungsten and molybdenum wire and rods are available in a wide range of sizes. For example, you can get it with an average particle diameter (as measured on the Fisher Sub-Sieve Sizer) of 10 microns and still the way up to 50 microns. General Electric tungsten metal powder can be made in any size range from 0.5 to 100 microns.

depending on such factors as mechanical properties, tolerances, finish and finish. This means you can now select the class best suited to the needs and requirements of your application and be assured that the sheet you order will meet or exceed your needs. The same is true for rods. You specify and buy the quality you require. General Electric will give you the class best suited to your use. The three classes are defined below.

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PRODUCT	FORM	TYPE	PURITY	ADVANTAGES
Molybdenum, cold-rolled	Flat	Primer metal alloy	Molybdenum, 99.95% min.	Thickness—0.001 through 0.305 in. Width—6 through 24 in. Length—up to 57 in.
	Sheet	Refractory metal alloy		
	Plate	Refractory metal alloy		
Molybdenum, hot-rolled	Sheet	Refractory metal alloy	Molybdenum, 99.95% min.	Thickness—0.001 through 0.305 in. Width—6 through 24 in. Length—up to 57 in.
	Sheet	Refractory metal alloy		
	Plate	Refractory metal alloy		
Tungsten, cold-rolled	Sheet	Primer metal alloy	Tungsten, 99.95% min.	Thickness—0.001 through 0.305 in. Width—6 through 24 in. Length—up to 57 in.
	Sheet	Refractory metal alloy		
	Plate	Refractory metal alloy		

PRODUCT POSSIBILITIES EXTEND TO ∞



THIN WALL TUBES AND CRUCIBLES—General Electric can make crucibles, large crucible tubes down the center of PS alloy or PS Tungsten as long as 12 feet. Tubes are available in O.D. sizes up to 12 inches. Maximum I.D. for any crucible tube is three quarters of the O.D. General Electric tubes are used as furnace susceptors, electrodes in vacuum arc melting, movable hardware and other applications. General Electric's unique molybdenum pressing technique lends itself to crucible forms, available in O.D. as up to 12".



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metallizing wire preferred for its tungsten wire to use, or in the form of standard wire for users who prefer to make their own filaments. General Electric offers the kind of tungsten in the form of regular strand, open strand and aluminum can strand for optimum results in metallizing. If you choose molybdenum, be sure to specify General Electric Tungsten Wire for the tungsten metallizing wire and filament coating.

IMPORTANT PHYSICAL PROPERTIES OF TUNGSTEN AND MOLYBDENUM

	TUNGSTEN	MOLYBDENUM
chemical symbol	W	Mo
atomic number	74	42
atomic weight	183.85	95.94
melting point	3422°C (6192°F)	2621°C (4750°F)
boiling point	5627°C (10151°F)	4912°C (8864°F)
density (at 20°C)	19.3 g/cm ³ (0.69 lb/in ³)	10.22 g/cm ³ (0.368 lb/in ³)
thermal conductivity (at 20°C)	173 W/m·K (12.5 Btu/in·ft·°F)	138 W/m·K (10.0 Btu/in·ft·°F)
thermal expansion (at 20°C)	5.4 µm/m·°C (0.00031 in/in·°F)	6.2 µm/m·°C (0.00035 in/in·°F)
modulus of elasticity	411 GPa (59.1 x 10 ⁶ psi)	328 GPa (47.5 x 10 ⁶ psi)
specific heat (molar)	24 J/mol·K (5.8 Btu/lb·°F)	24 J/mol·K (5.8 Btu/lb·°F)
atomic type	body centered cubic	body centered cubic

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through the atmosphere. These signals, transmitted from the reentry vehicle, would be received on the four ships. Arrival time of the signals would be related to the known time base, coded along with the ship's position, and relayed to a control room for the recovery operation. In the control room, a computer would calculate the accurate position of the reentry body and establish a predicted trajectory and impact point.

Feasible Errors

Any system is only as good as its maximum permit it to be. The Loran-C system has several possible sources of error which could be contributing factors to the final position or prediction error.

Loran-C is a hyperbolic system in which positions are defined by the intersection of several hyperbolic surfaces which in turn are defined by the arrival-time differences of signals from more than one transmitter. In the re-entry situation, the problem is reversed: the hyperbolic surfaces are defined by the arrival time of the four ship stations of a single signal coming from the re-entering body.

The accuracy of the position determined from that data depends on the accuracy of the signal time and the way that timing changes with position changes. Sensitivity of the signal timing to position changes depends on the angle subtended by the lines of sight between the receiving stations and the reentry vehicle. If the vehicle were to be overhead at an elevation about equal to the base-line distances involved, the sensitivity would be reduced by a factor of about two compared with the best sensitivity obtained of about two micro-seconds per 1,000 ft change in position.

If the vehicle is at the maximum range of 1,600 mi., the sensitivity would be reduced by a factor of 16 to 20, depending on the length of baseline and the direction of approach.

Surface Displacement

Since each of the position fixing surfaces is subject to that same vector, the displacement of a single surface causes a much larger displacement of an undefined position, depending on the orientation of the reentry vehicle. Since any point in a region of good accuracy the uncertainty of position would be about twice as large as the displacement equivalent to the timing uncertainties. This will increase to 50 to 100 times the timing error at the limit of coverage.

Because of the variation of electrical properties of the atmosphere, the distance corresponding to a given signal delay will have an error of at best one part in 100,000. The atmosphere has

that it will signal depending on the frequency of the signal.

These uncertainties can be corrected with the best data available, and result in a propagation velocity determination which is correct to perhaps one part in 20,000.

Position Uncertainty

This latter uncertainty plus the error due to the uncertainty in determining the intersection of the hyperbolic surfaces determine the overall position uncertainty. In the case of a reentry vehicle directly overhead, the total position error could be expected to be about 300 ft. At 1,600 mi range of

the reentry vehicle, the position error would be on the order of three miles.

Since engineers make one more extension to the Loran-C system in that proposal, which would make its principles applicable to more accurate doppler tracking. Since aircraft thought it desirable would looking the Atlantic and Pacific Loran C chains for time synchronization.

If they were done, then a constant time base with increased accuracy would be available across a distance approaching one earth diameter. The advantages that would result from such a large baseline for doppler tracking are obvious.



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Design such as solar collectors, thermoelectric propulsion systems, thermoelectric generators and the liquid metal cell represent areas of concentration at



excess—both steel and titanium—for 16 in. in a KCM-20. Allison has developed an accurate and velocity control device to apply “power steering” for missile and space craft from small to the largest types such as Nike.

Along with its missile and space activity, Allison is maintaining its versatile posture as designer and producer of air-breathing engines by developing

three advanced types of air-breathing engines; turbo-prop engines with a regenerative cycle for maximum fuel economy to increase aircraft range as much as 35%; a compact, lightweight, small turbo-prop selected as the powerplant for the Army's next generation of Light Observation Helicopters; and thermally regenerative gas turbine engines for a wide range of subsonic and supersonic use.

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which our engineers and scientists have made notable advances. As the missile fuels, Allison is producing first and second stage rocket engines

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Study and preliminary design of advanced power systems for space and terrestrial use.

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Design of advanced air-breathing engines for aircraft, vehicle and industrial applications.

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PRODUCTION BRIEFING

Metrix Co.'s Research Institute for Advanced Study, Bethesda, Md., will study the effects of cosmic light on photoreceptors in support of the Navy's research on the field of spacecraft life support systems. Work is sponsored by a \$62,450 contract from Air Force's Aerospace Medical Division.

Boeing Corp.'s Power-Control Division, Chgoport, Iowa, has received a \$257,900 contract from the Boeing Co. for design and manufacturing of electronic instruments which will measure the amount of engine fuel in the hydrogen and oxygen tanks of the X-20 DynaSoar space glider. Boeing also awarded a \$257,000 contract to Comstar Corp., Hawthorne, Calif., for controls to monitor constant pressure in the X-20's compressed oxygen tanks.

Allego Scientifics, Inc., Fort Anson, N. T., will develop steering control for the S-4 stage of the Saturn booster under an \$818,490 contract from Douglas Aircraft Corp. Contract calls for an extension which will independently cover the S-4 stage engines.

Kellett Aircraft Corp., Wilkes-Barre, Pa., has received a \$228,712 contract from the Bureau of Weapons for outboard study of the effects of downwash on the operation of VTOL aircraft. Kellett is charged with preparing the VC-41 to simulate VTOL aircraft operation will be used.

Cosmos Aircraft Co., Wichita, Kan., has been awarded a \$455,000 contract by the Army's Transportation Materiel Command for five C-130C helicopters which will be used in the Military Assistance Program. Deliveries will start in December, 1962.

Rockwell International, Inc., will build a reinforced carbon dioxide wiring system for Project Mercury spacecraft under an \$58,000 contract from the National Aeronautics and Space Administration. Device will consist of four-carbon dioxide device system and solid-state supplies which will monitor carbon dioxide buildup in the spacecraft.

Moscow Precision Industries, Inc., Cedar City, Utah, has received a \$490,000 contract from Westinghouse Electric Corp. to build from three and four elements for the atomic and transmitting phases of the compact radar system used on the Navy's carrier-based A-1H fighter-bombers.



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TWO INFRARED HORIZON SENSORS in Mercury capsule determine direction to center of the earth to provide vertical attitude reference by measuring the thermal brightness of the earth about pitch and roll axes. The life horizon sensor, polished by Kansas Engineering, is shown (right) installed in test fixture which simulates earth

Infrared Sensors in Space—Part 2:

Cold Clouds Troubling Horizon Sensors

By Philip J. Kline

Washington—Infrared horizon sensors, used to provide earth-attitude reference and stabilization both for manned and unmanned satellites, have encountered trouble from an unexpected phenomenon—clouds at unusually high altitudes which appear cold rather than warm. At lower altitudes, clouds reflect sunlight and therefore have a warm appearance in the infrared spectrum.

Cold cloud problem appears poised to resolve some of the use of detecting KIRNS, which is delaying the Midas early warning satellite program (AW Sept. 24, p. 24). Specific difficulties have greatly eased the problem for the Mercury capsule sensor and supported lives are under development.

But spurious cold cloud effects do not appear to be the explanation for the large error in pitch axis reference reported by Cdr. Scott Carpenter during the Mercury MS-7 mission. In fact, no extensive investigation by the National Aeronautics and Space Administration, by McDonnell Aircraft and by Boeing Engineering, which supplies the Mercury horizon sensor, has so far failed to pinpoint the basic cause.

Major cause of early delays in the NASA Nimbus meteorological satellite

has been problems with the infrared horizon sensors used for attitude stabilization. These, too, have been attributed to effects of spurious radiation from clouds (Hosover General Electric says it has redesigned the sensor to get around the difficulty).

Infrared horizon sensors for spacecraft have been developed or are under development by several companies. Boeing Engineering, one of the pioneers in this field in supplying horizon sensors to Lockheed for use in attitude stabilization of Agena vehicles in all USAF satellite attitude programs in addition to the Mercury capsule units, also is supplying infrared horizon sensors for stabilization of the Sincletre Jupiter (Soviet) vehicle under development by Radio Corp. of America. Horizon sensors for the two-man Gemini space capsule and the Orbiting Geophysical Observatory will be supplied by Advanced Telemetry Laboratories, Mountain View, Calif. The horizon sensor for the Nimbus is being developed by General Electric's Missile and Space Division, Martins-Baltimore in producing a horizon sensor under NASA contract for end-of-the-line use.

Functionally speaking, the infrared horizon sensor might more appropriately be termed a "vertical sensor" since that is its purpose—to establish the

direction from the spacecraft to the center of the earth.

Two or more infrared sensors usually are used to establish the attitude of the satellite with respect to the thermal surface of the earth, after which the center can be determined by simple geometry or equivalent. Because the earth is warm, with an average temperature of 280K (50°F) in the moderate zones, it should provide a well-defined thermal outline against cool space.

Once the direction to the center of the earth (level vertically) has been established, a signal is available, which can be used to operate gyros in other control mechanisms to stabilize the satellite attitude with respect to vertical.

Or the signal can be used to erect a vertical gyro as in the Mercury capsules, in which the same with that a small pendulum is used in a conventional inertial vertical gyro to prevent drift and keep it aligned to the vertical. A pendulum or other accelerometer can be used for this purpose as a vehicle because the whole vehicle is in a zero-g condition.

In the Mercury capsule, two separate infrared horizon sensors are used one for the pitch-axis reference and the other for roll-axis reference, both



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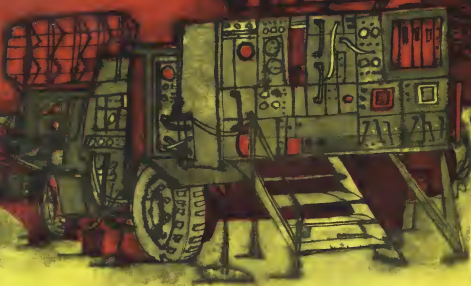
range blow or go in on the deck to support troops. And with its all-weather capability the F-105D can look on target, deliver accurately, get home safely—in the kind of weather storms choose to fight in.

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mounted in the nose of the capsule. Each of the 3-hr. horizon sensors contains an infrared detector, optics which give the detector a 2×8 deg. field of view and a motor-driven scanning prism which causes the field of view to go through a conical scan at 30 rps.

The infrared detector "looks" out ahead (or behind) the capsule for roll axis reference while the pitch-axis scanner looks out to the side. When the capsule attitude is such that the sensors can see the earth, the infrared radiation impinging on the detector increases sharply as it scans the edge of the warm earth. It should remain at this high level until the detector scans past the earth and again looks into space, at which time the signal should drop sharply.

Thermal Boundaries

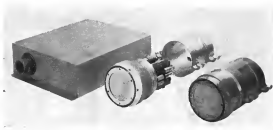
By this means one horizon sensor determines the thermal boundaries of the earth about the capsule's pitch axis while the other sensor does the same about the roll axis. This determines the angle which the earth subtends along each of the two axes. Bisection of this angle establishes the vertical, i.e., earth center.

If the earth emits sufficiently high radiation over the scanned surface, this angle bisection can be accomplished conveniently by thermal-electric means. Specifically, giving circuits into which the infrared detector signal feeds can be set to trigger when the signal reaches a predetermined threshold, considerably above the energy level when the detector is looking at cold space. Clipping the output off energy which is significantly greater in intensity than the threshold value.

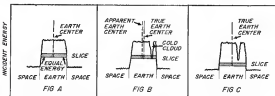
The result is a "slice sample" of the energy received by the detector between two specific energy levels across the spectrum bandpass of the system. (See Fig. A.) By locating the point along the slice, corresponding to position of scan across the earth, where the energy in one segment of the slice equals the energy of the other, the position of the vertical is established.

The technique, which Barnes uses in its horizon sensor for Mercury, is relatively insensitive to reflected sunlight because its germanium optics filter out most of the sunlight energy which occurs at wavelengths shorter than about 1.8 microns.

During the first orbital flight of an unmanned Mercury capsule, telemetry data showed that the horizon scanners were not performing properly during intervals. This led to an investigation that first suggested that the apparent radiation temperature of very high altitude clouds, as seen by the horizon scanner, was as low as 170K. This temperature was considerably colder than had been expected.



AGENA HORIZON SENSORS, similar to those used in Mercury, are used in Air Force's Discover program, primarily for earth orientation of Minotaur and Samos satellites.



EXPLANATION OF HORIZON SENSOR cold-cloud problems and subsequent cure: Earth center is determined by dividing sample slice into two segments that contain equal amount of infrared energy (A). But passing over very cold clouds comes energy dip which penetrates slice, creating false vertical (B). Lowering slice threshold cures the problem (C).

When the spacecraft passes over such high, cold clouds, the energy level received by the infrared detector falls drastically, almost as if the scanner were looking at cold space instead of at the warm earth. If, under these conditions, the received energy falls below the level of the slice, it upsets the balance, and the technique used to "hook" the earth's subtended angle gives an erroneous indication of the vertical. (See Fig. B.)

Quick Fix

As a quick fix for this problem, Barnes decided to lower the energy level, or threshold, of the slice sample so that sharp dips produced as the satellite passed over cold clouds would not drop low enough to penetrate the slice and thereby upset the thermal balance. (See Fig. C.)

Where previously the slice threshold level had been set at about 50% of the normal radiation level emitted by the earth, the value was dropped to about 25%, according to Eric M. Womser, vice president and general manager of Barnes Defense & Space Division.

The improved horizon sensors were first flown in the MA-5 orbital mission (with chimpanzee astronaut) to evaluate the fix. During the flight, the outputs of the two scanners were recorded

continuously during five eight-minute intervals. And during one of these eight-minute periods, photographs were made through the capsule's periscope of the earth horizon at 10-sec. intervals to provide a means for evaluating sensor performance.

Subsequent analysis showed that when passing over high cold clouds, the energy ranging on the detector often fell to less than 50% of normal value and occasionally dropped to as low as 5-10% of normal value. The photos also suggest that usually these high, cold clouds are associated with severe weather disturbances, such as hurricanes.

Transient Effect

Under most conditions, the cold cloud effect has only a small transient effect on the performance of a satellite attitude stabilization or reference system, causing it to align briefly to a slightly erroneous vertical.

In the Mercury capsule, the vertical (attitude) zero is slaved to the horizon sensor determined vertical at a maximum rate of about seven deg. per minute. That is, if the horizon sensors are misled by cold clouds into establishing a false vertical, the vertical zero can only move toward this false vertical at seven deg. per minute. Unless the satellite is over such cold clouds

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for an extended interval, they should not introduce a significant error into the attitude gyro readings.

Analysis of the MA-5 photos shows that when the horizon scanner was not disturbed by cold clouds, they can determine direction of earth vertical to within one deg. or less. Horner says.

The improved horizon sensor, with lower (25%) size threshold, were used in the first manned Mercury mission (MA-6) without reported difficulties. However, during the options phase of the subsequent MA-7 flight, selected data indicated a discrepancy of approximately 20 deg. between the pitch axis sensor of the Atlas horizon gyro and the capsule's pitch-axis control system.

Since the horizon gyro served as reference for correction, which was successful, it is assumed that the error was in the pitch-axis scanner of the capsule. The only independent reference is the inert tracking data which, in subsequent analysis, appears to confirm correctness of booster gyro.

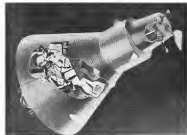
During the second orbit, while in contact with the Indian Ocean ship, Carpenter reported "the gyro did not seem to be indicating properly," but he then quickly added "And that is not correct either. The gyro are all right, but an ASCS (Automatic Stabilization and Control System) standby. It may be an orientation problem. I'll create trouble and... size of that will help me out the ASCS problem." At this point the Capsule Communicator on the ground asked a question about the astronaut's blood pressure and his attention was diverted from the gyro reference problem.

It was not until later in the second orbit, while in contact with the Indian station, that the Capsule Communicator returned to the problem. "Would like the gyro to achieve zero green to normal [fixed to horizon sensor] and use what kind of indication we have whether or not your sensor runs again with your gyro?" (The weapon has a visible mark which should align with the earth horizon when the capsule is in the correct 34-deg. nose-down pitch attitude for firing the retro-rockets.)

Before Carpenter could make this check, his attention was diverted by the white luminous patches which Col. John Glenn had reported seeing during the MA-6 mission. By that time the capsule was approaching California where a decision had to be made as whether to go for a third orbit, so interest shifted to the astronaut's blood pressure and his capsule oxygen and fuel supplies.

The problem did not come under scrutiny again until the capsule was over Hawaii on the third pass and Carpenter was beginning his re-entry check-list readings. When ASCS is operating properly, it can be used to automatically place the capsule in the required 34-deg. nose-down pitch attitude required to initiate the re-entry phase of the mission.

With only six minutes to go before reentry, Carpenter reported "I have an ASCS problem here. I think ASCS is not operating properly." About 10 sec. before reentry, Carpenter reported "I don't have agreement with ASCS in the window," indicating that the



TWO INHIBITED HORIZON SENSORS in use of Mercury capsule aim to determine direction and rate of nose with respect and speed to local center of earth. This is used to keep capsule attitude gyro correctly aligned.

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automatic control had not properly aligned the capsule in pitch.

Carpenter finally loosened the auto auto control system and used his manual controls to stop capsule attitude, using the window scale mark as a reference.

Automatic studies of the identified and type window data made about the capsule, as well as later discussion with Carpenter, indicate that the 20 deg pitch error apparently control through out the mission, but that the roll error was not apparent in fracture properly. These studies have been made by NASA, McDonnell and Barnes.

MA-7 Difficulties

The magnitude of the error, as can be seen from the proper operation of the roll-axis sensor indicates the MA-7 difficulties were not due to cold cloud solution, according to Donald Philbin, Barnes project engineer.

Any conclusive performance is difficult because the nose package containing the fuselage sensors is ejected during reentry and not recovered.

Barnes' studies of the accident show three possible reasons for the failure, any which might have caused the large pitch error. These range from a 10° loss of gain in one transmitter to a specific capacitor becoming extremely leaky.

McDonnell has investigated the possibility that acoustical heating of the capsule nose during launch, immediately after the escape tower is jettisoned might have heated into the loss of gain in the pitch sensor. This test has been experimental, but not yet thought to have been corrected by means of thermal insulation. Although no evidence has been found to indicate this was the cause, additional investigation can be added to MA-7 as a post-mortem exercise.

Sever Recovery

A spokesman at NASA's Mission Space Flight Center Houston said that post-mortem was to be added to the next post, but the MA-7 to permit recovery of the horizon sensor for a detailed post-mortem if the fault should occur again.

But the engineers of the investigation by NASA, Barnes and McDonnell on the MA-7 troubles is "close to home."

However, a NASA spokesman at Houston told Aviation Week that the MA-7 mission profile will call for the instrument to make performance checks on the ASCS and horizon sensor only in the mission "only visual" intervals of the earth as viewed through the periscope and window.

Additionally, the mission profile will call for the instrument to rotate its attitude preparation each orbit in the

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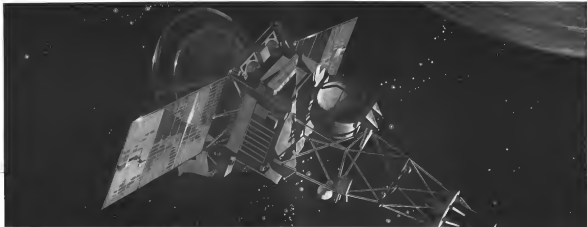
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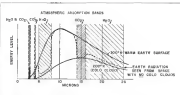
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INFRARED ENERGY EMISSION In warm earth (top solid trace) is heavily attenuated by carbon dioxide and water vapor in atmosphere at wavelengths shown, so that energy from earth area is negligible. However, some energy is shown in dotted line when there is no cloud cover. Fairly solid, high-altitude clouds have reduced radiation characteristics similar to thick body with fragments of 200% lower solid curve. From satellite sensors some solar heat of short wavelengths through atmosphere (isolated trace) which means they experience a sharp drop in energy level when passing over cold clouds (large difference between dotted and lower solid curve). More advanced human sensor now under development will operate in the 14-16 micron region, have carbon dioxide absorption band, where there is relatively little difference between energy level of attenuated warm earth radiation and that emitted by extremely cold, high-altitude clouds to prevent cross now experienced.

current to provide time to analyze any difference which may turn up and avoid the "Villager's" experience at the MAJ, with its subsequent over shoot of the intended recovery area.

Although there is no modified its rapid human sensor design to enable it to view areas closer which are as much as 50% colder than the earth without adverse effects it is exploring more advanced techniques for future designs.

One new technique in hand can design the sensor optics to operate at longer (cooler) wavelengths. In the 15 micron band, for example, carbon dioxide in the atmosphere absorbs radiation of this wavelength from the earth and satellite, they measure it. A sensor operating in the 14-16 micron band should thus see the earth profile in virtue of the infrared radiation from the carbon dioxide shell which encloses the earth.

In this strong carbon dioxide absorption region, it is believed that the earth will appear to have a nearly uniform temperature of about 280-290K, corresponding to the top of the atmosphere. Because the sensor is sensitive only in the cooler portion of the infrared spectrum the cold clouds should cause only minor variations in the energy and appearing as the detector is hovering the range formed by the earth's carbon dioxide shell, it should be possible to determine the local vertical, as well as the present season.

The AF Cambridge Research Laboratories will take a similar approach and are working on a narrow band infrared detector with sensitivity centered in the same region.

Admittedly, there will be less concern between the atmosphere and space at this cooler wavelength, but it should be sufficient for substitution operation. Worries believe. One problem area is the design of a long-wavelength sensor to obtain optical responses with good transmission efficiency in the 14-16 micron band which can also withstand the hostile space environment. Another problem area is obtaining efficient infrared filters to exclude longer wavelengths beyond this band. However, Bureau reports that it is making encouraging progress.

(This is the concluding article in a two-part series. First part appeared in Aviation Week, Sept. 24, p. 54.)

GE, Toshiba to Form Electronics Company

Tokyo-General Electric Co. and Tokyo Shibaura Electric Co. Ltd. (Toshiba) will form a new electronics company to build and supply goods to air systems and accessories for Japan's Self-Defense Agency.

Formal agreement was made recently to the Japanese Ministry of International Trade and Industry for permission to form the new company, which will be called TESCO (Toshiba Electronics Sales Co.). It will be capitalized at 500,000,000 yen (Toshiba owning 50% and GE 40%).

TESCO is being formed to meet increasing demands from the Self-Defense Agency for production and overhaul of AN-179-2 and ground radio systems, angle indicators and photo-electric sighting devices.

FILTER CENTER

New High Intensity Laser-New type laser-nance gas laser which operates in direct continuous (dc) mode at a wavelength of 1.19 microns the longest wave length yet reported except for carbon laser has been "discovered" researchers at Spectra-Physics Inc., Mountain View, Calif. Company says new laser produces more power and has a higher gain per unit length than any other infrared laser yet developed. Power output of 10 mw. have been obtained from a discharge tube 115 cm. long by 9 mm. diameter. Its stable selection of reflecting mirrors, laser can be made to emit visible light only, infrared or combinations of both. When both colors are released laser operates from a significant effect on the visible being strong, Spectra-Physics reports.

Higher Laser Efficiency Predicted Efficiency of laser in converting electric (generator) energy into radiated light, which exceeds 10% has been predicted, can be expected to rise to 10-20% in a few years and ultimately perhaps to 50% or higher, according to Dr. C. H. Townes, who discovered laser action. However, such efficiencies will not necessarily be obtained with lasers that also have high power output and short duration pulses, according to Townes. Townes, currently physicist at NBS, made the forecasts in a Portuguese seminar sponsored by AFPA.

Plasma Frequency Sensor Reported Techniques which permit direct measurement of the plasma frequency of an excited medium may which electron density can be calculated, has been developed by Upper Air Research Laboratory of the University of Utah and membership of Air Force, Cambridge Research Laboratories. Techniques, outlined in a report submitted by O. C. Hirsch and K. D. Baker, use depth, return measured on remote vehicle which is installed in a low-altitude frequency source whose frequency can be varied. Antenna voltage and current are compared with the plasma frequency. When the two are in phase the resulting frequency is the plasma frequency.

New Type State Transformer An electronic circuitry state transformer which experiences a thousand-fold change in impedance when subjected to a stress of a few thousand dynes using a specially designed characteristic of ultra-sonic material, P.N. parameters was reported by W. Ruckenstein and Raymond Nelson of Rutherford. Sensitivity is high determined by piezoelectric effect and impedance as depth decreases.

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11-100

Electronic Data Systems Surge Predicted

By Donald E. Fink

New York—Increase in dollar value of the electronic information systems market from \$1.5 billion in 1965 to about \$5.5 billion by 1967 was predicted last month at a seminar, marking, in person held in conjunction with the Electronic Industries Ass'n's fall conference.

Predictions were made by a five-member panel which presented a market forecast extrapolated from government budget housing figures. ICA files and electronic companies projections. Modest was Harold Rogerson, vice president of International Electronic Corp. Panel members were Dr. R. P. Bielecki, Martin Co.; Abraham Ritz, Radio Corp. of America; Harry Kett, International Electronic Corp.; and William Osherson, vice president of CTR, Inc.

Five-Year Period

Purpose of the symposium was to define the general area of information systems and their command and control applications, discuss major components of information systems and predict their market value over the next five years. A longer period was considered but it was dropped because

the projection became too uncertain. While numerous factors will influence growth of the information systems market, three main assumptions were listed as being the most significant.

- Continuation of the present interest level of defense.
- Continued emphasis on development of command and control systems.
- Substantial increase in activities across command and control systems.

Largest total market and the largest rate of increase were forecast for the aerospace communications field, with the 1967 market estimated at \$774 million. Of this, \$406 million was attributed to military applications, with the remainder being attributed to be expected from government agencies such as Federal Aviation Agency and National Aeronautics and Space Administration.

By 1967, the panel predicted, this market potential will have increased to \$2,075 million, of which \$1.3 billion will be for military applications. Largest single market field will continue expenditures for command and control systems. This was estimated at \$406 million in 1967 of a total military and aerospace market of \$810 million. By 1967, it will have in-

creased to \$1 billion of a total \$1,010 million market.

Command and control systems, were termed keys to successful management of war programs such as the U.S. military, communications and control program and the nation's worldwide command setup.

Indicating increased emphasis on aerospace mobility in the next five years, the panel predicted greater Air Force responsibility for mobile command and control systems, now most provided by Navy and Marine Corps. Air Force is pushing for land systems, an expected increase during the "sea" period while expenditures for mobile systems increase until Army becomes their biggest user (AW Sept. 24, p. 61).

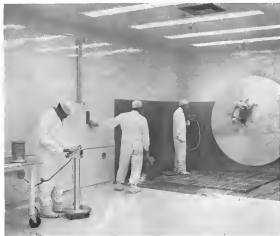
Critical Areas

During the discussion of major information systems components, it was pointed out that data transmission rate of the circuit has not kept pace with developments in related fields. Two major areas in which need for improvement will become critical in the near future include pulse techniques, power-weight, antenna efficiency, or cover sensitivity and more selective. The market in data transmission equip-

Information Systems Market Expected Growth

(in millions of dollars)

	1962	1964	1965	1966	1967
COMMAND AND CONTROL					
Military	880	908	920	938	1,000
Navy-MC	10	10	10	10	10
Both	810	898	910	928	1,010
MANAGEMENT CONTROL					
Military	300	300	300	304	375
Navy-MC	13	23	20	24	58
Both	313	323	320	328	433
AIR TRAFFIC CONTROL					
Military	100	100	110	120	130
Navy-MC	123	123	120	120	120
Both	223	223	230	240	250
AEROSPACE COMMUNICATION					
Military	400	400	400	400	1,000
Navy-MC	116	116	116	116	116
Both	516	516	516	516	1,116
SURVEILLANCE AND INTELLIGENCE					
Military	272	321	311	311	311
Navy-MC	46	34	40	42	42
Both	418	455	451	453	353
GENERAL SUPPORT					
Military	300	444	471	521	550
Navy-MC	41	61	61	61	79
Both	441	505	532	582	629
INFORMATION MANAGEMENT					
Military	10	20	20	20	20
Navy-MC	10	10	10	10	10
Both	20	30	30	30	30
RESEARCH AND DEVELOPMENT					
Military	30	30	30	30	30
Navy-MC	47	100	120	120	140
Both	77	130	150	150	170
GRAND TOTALS					
Military	2,412	2,700	2,711	2,772	3,138
Navy-MC	104	1,230	1,480	1,504	1,516
Both	2,516	3,930	4,191	4,276	4,654



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Solar-built cryogenic and hydrocarbon systems for the nation's most sophisticated aerospace projects are cleaned and packaged in

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Designed to NASA standards, the LOX cleaning area is typical of Solar's modern, complete aerospace facilities. In it, the newest methods are used to assure the required "surgical cleanliness" of missile parts.

The Solar LOX cleaning facility is fully equipped for hydrocarbon or alkaline cleaning methods. The clean room itself is pressurized and has an air supply system that delivers 3500 cu ft per minute, filtered at 5 micron and below.

Throughout the cleaning pro-

cess, Solar maintains rigid safety and quality controls to assure that all standards are met or bettered.

A special assembly area, where cleaned parts and assemblies are protected from contamination, is an integral part of the facility. For more information about Solar's complete LOX cleaning facilities or unique capabilities, write Solar, Dept. K-167, San Diego 12, Calif.



ment alone, estimated at \$1.1 billion for 1965, is expected to reach \$2.5 billion by 1967.

It also was predicted that producers of data transmission equipment will face increasing competition during the period because of the wide range of equipment which will be developed and produced intensively by users. The larger companies will have the advantage, since they will be able to produce a wider range of equipment. Smaller companies will be pushed further into the ranks of subcontractors, according to the panel.

In the field of display components for information systems, it was pointed out that military expenditures account for 75-80% of the present market. The non-military market was deemed unstable, both in technology and user requirements, since concentrations in the past had been predicated on special military needs.

Extent of FAA enlargement of control display devices, for example, is uncertain at present, but future needs to meet increased traffic control loads hold potential for a large market. The control display market, estimated at \$19.9 million for 1965, is expected to reach \$55.6 million by 1967.

Software, the term applied to programmed extension of an information system, was another area requiring advancement. Methods of interpreting data to be fed into the system and quality control of the output have not kept pace with the increasing effectiveness of the equipment components of the systems, thereby reducing the overall efficiency.

Turning the software market a mass of accelerated demand, the panel also cited that the immediate future will see a large demand for training programs which will produce more technical writers and highly skilled systems operators. The demand for the training programs is expected to taper off in the latter part of the five year period.

Test System Bids

Fifteen companies are expected to bid for a contract to develop a ground support automatic test system designed for combined depot use to check out and trouble-shoot three widely used Air Force electronic communications and navigation equipments—the AN/ARC-16 UHF communications set, the AN/ARC-21 T-124 navigation receiver and the AN/ARC-161 Doppler radar navigation system. Delivery of the first prototype equipment is to be within 18 months after contract is signed. Procurement is being conducted by the Middlebrook Air Materiel Area, Orlando, Fla.

ACTION MEMO
FROM: Value Analysis Manager
TO: J.M.H.
Date: 7-31

These Cherrylock features mean lower installation cost. We should save money in purchasing and manufacturing - fewer rivets to buy and stock - less chance of installing the wrong grip. We authorize an immediate evaluation.

Hol



- Positive Mechanically Locked Stem
- No Rivet Fracture (No Stem Trimming)
- Strong Clinch
- Wide Grip Range
- Positive Hole Fill

United States Patent No. 3,021,353. Quantities under M&E specifications 1450 and many Standard Project Nos. 12718 and 12719. For technical data on the Cherrylock® 2000 Series rivets, write Townsend Company, Cherry Rivet Division, Box 2127 H, Santa Ana, California.

Cherry Rivet Division
Santa Ana, Calif.



Townsend Company

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In Canada: Penstock & Bullock Manufacturing Company, Limited, Gloucester, Ontario



FERRETING

ECM

Modern electronic countermeasures are an integral element and intelligence tool for the military services. "Ferreting" ECM systems—for the detection, location and analysis of foreign electromagnetic radiation associated with radar, missile command and communications—are a demonstrated capability of Babcock's Military Products Division, where operational ferreting systems are in production for the Navy. Babcock's skilled team, with an established reputation for providing field-ready reliability in a wide range of military qualified electronic systems and components, is conducting advanced research and development to provide solutions to new problems in ECM.

MILITARY PRODUCTS DIVISION

BABCOCK ELECTRONICS CORP.
1940 Morroca Avenue, Costa Mesa, California

NEW AVIONIC PRODUCTS



• **Tekatronics amplifier, Model F-10A**, a miniature VHF early amplifier providing 25 m. output at an operating plate efficiency of 65%, is condenser cooled and suitable for space and missile applications; ground-load VHF transmitters in special kit equipment. Amplifier occupies 2.17 cu. in., weighs 16.5 oz., has maximum bandwidth of 2 mc in operating frequency range from 250 to 250 mc. It is designed for -20 to +85°C temperature range, and will withstand 15g throughout 10 to 2,000 cycle range.
Manufacturer: **Radiol Engineering Corp.**, 990 S. Fair Oaks Ave., Pasadena, Calif.



• **Microsare klystron, Model 88K-201**, a shielded reflector klystron suitable for use as a pump power for parametric amplifiers, delivers 50 mw. d.c. power and is mechanically tunable over the 1000 mc range from 23 to 24.5 gc. Measuring tube weighs 31 m., is rugged and has low inoperative coefficient to enable it to offer stable operation in airborne and ground installations. Manufacturer: **Sperry Rand Corp.**, Sperry Rand Corp., Greenwich, Fla.

• **Subminiature turbolapse gage, Model 250A**, a piezoelectric transducer which monitors dynamic pressure in air, gas or liquid from 0.01 to 50 psi while measuring static loads. Sensitivity is 450 mv./psi., with frequency response from 2 cps. to 50 kc.
Transducer measures 0.368 in. dia. x 0.255 in. long, weighs 3 grams excluding cable.
Manufacturer: **Eadevco Corp.**, 801 So. Arroyo Parkway, Pasadena, Calif.

• **Subminiature repeat-cycle timer, Series 4, 906** for d.c. and Series 25, 909

for 400 cps. applications, are available with cycle times of 5 sec. to 25 min. in the d.c. model and 1/2 sec. to 90 min. in the a.c. version. Up to 10 switches can be paralleled. Single-switch models measure 2.0 in. long, while an eight-switch unit measures 4 1/2 in. Single-switch model weighs 60 m. Normal operating range is -55°C to 85°C, but ranges are available for 125°C operation. Device is designed to operate under 10g vibration, 1-100 cps., or more on special order.

Manufacturer: **A. W. Hixson Co.**, 232 North Elm St., Watertown 16, Conn.

Nanocircuit of the Month



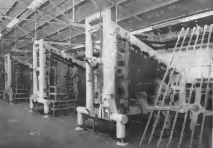
Flip-Flop for Satellite Communications

Performance to 55 MC. Operates over the full MIL range from -55° to +125° C.

This is the last step in the evolution of nanocircuitry. General Instrument developed the concept of the multi-chip nanocircuit for maximum flexibility and performance. Now General Instrument offers the same performance with partial integration of the resistors, capacitors, diodes and transistors. A complete line of General Instrument nanocircuits is immediately available in a variety of package configurations for many applications, and your nearest sales office, branch office or work in Riverside, General Instrument Development Division, 400 Lake Street, Milpitas, Long Island, N. Y.

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

General Instrument Corporation



European F-104G Production Increases



MegopaK Exotic?

Only by association. Because of their speedy response and flexibility, MegopaK temperature sensors are being used in some of the most advanced scientific projects of our time. Modern industry, research, space age and atomic projects are using MegopaK sensors, and using them! To meet the demand, we now offer more than 70,000 different combinations of MegopaK components from factory stock.

You see, a MegopaK unit is a very precise and practical thermocouple, converting of mineral-insulated thermocouple wires, solidly compacted within a corrosion-resistant metal sheath. It has exactly what it takes to mean accurate and precise temperature, high response speed, simplicity of construction, long useful life, small diameter (1/32" and even smaller on special order) and measurement ranges up to 3000°F. It can be had in lengths up to 50 feet. One of its greatest advantages is flexibility; it can be bent on the job to measure in spots that bulkier and rigidly mounted sensors couldn't begin to reach.



satisfaction now that it's at work.

Again, a leading builder of spacecraft considers MegopaK thermocouples "most important" [see words to the success of this highly critical application].

The MegopaK assembly is a typical Honeywell "family" advertisement. Developed at our Corporate Research Center at Hopkins,

Miss., it received the early attention of some of the world's leading authorities in thermocouple metallurgy and insulating materials. It is manufactured under space-and-sea conditions at a new facility in Philadelphia. Strictly controlled processing and specially-designed equipment make it possible to reinsert the assembly tightly with an uncertainty in resistance or distortion of the wires. Finally, the completed MegopaK unit is 100% inspected at 500 V d.c. to make sure that every inch meets the highest possible standards.

Naturally, all this attention to detail is reflected in the price. You could probably find something that looks like a MegopaK sensor for considerably less money. It all depends on how much reliability and precision you're willing to pay for.

Whether you are interested in measurement across the entire temperature spectrum, or only a narrow segment of it, you'll find that the best answer comes in temperature measurement and control can be of distinct help to you. We'll gladly put our long and varied experience at your disposal in selecting sensors, instruments and data handling equipment. If you like, we'll install them for you, and guarantee they'll work. Tell us your needs with your nearest Honeywell field engineer, or write A. E. Finn, MNNR40103-1, HONEYWELL, Wayne & Western Avenue, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ont.

Honeywell

 First in Control



J79 Engines Produced in Europe for F104s

Three European firms, BMW Turbomotors of Garmisch, Ingels FN Wels and Fiat of Turin, are producing components and main engine complete General Electric J79 J43 turbojet engines in years European built F104G fighters. Fiat, alone with Alfa Romeo as suppliers, manufactures intake and valve blades and will assemble

262 complete engines. BMW, before, maintains a 100% assembly line at its main plant near Munich. Company currently is producing 18 engines per month and will assemble 612. Ingels FN will assemble 154. Approximately 30% of the components are from General Electric stock in the United States.



**JUST ONE CRIMP DOES IT!**

With all OSARKON® connectors you get simultaneous air crimp termination of inner conductor, outer braid and cable support. This exclusive AMP feature results in a more than 50% strength is applied down over other solderless closed connector assemblies—even those when compared to those applied by solder. The contacts are pre-assembled, furnished ready for attachment. This means no assembly costs resulting from time loss and production slow ups. Add to this the low initial cost (spread lower than comparable crimp engagement) and you have the most economical coaxial connections on the market—by far!

PERFORMANCE

Performance, but what about quality? Test reports confirm minimum discontinuity up to 500 megacycles. At 500 megacycles impedance mismatch is only 1.09 to 1.09. And with the plus feature of AMP's matching tool and terminal technique, you further insure reliability by eliminating human error, hot or cold connections, cold solder joints.

THE STANDARD OF EXCELLENCE

OSARKON® non porous gold over 99.999% nickel contact

*Reprints of AMP literature only

plating is standard with AMP. This combined with cantilever beam contact retention springs assures you of maximum conductivity, uniform contact pressures, longer insertion/withdrawal life.

Choose from a wide range of OSARKON connectors—single in-line, bayonet and threaded nut types, multiple, in a wide variety of configurations, including coax and pin and socket cases. Standard, miniature and sub-miniature contact sizes will handle a primary derivative line—broad range of OAD® to 1.60".

Just add up the advantages: speed of application, lower initial and applied costs, low noise level, superior plating wide selection. Then, put an AMP® and to your coaxial connection problems. Get the sample to every today!



AMP products and engineering facilities distributed through authorized distributors in Canada, Australia, Japan, France, Holland, Italy, Japan, Mexico, and West Germany.



Flight view of Beagle M.218 executive twin-engine propeller aircraft and swept tail. Aircraft is about 67% glass-fiber reinforced plastic. Span is 37 ft. and length is 27 ft. 5 in. Gross weight is 5,100 lb. M.218 is now produced at the European market.

Plastic Used in Beagle M.218 Twin Construction

Beagle M.218, second executive twin to be produced by the British, is powered by two Rolls-Royce Conquest 10-700 engines of 245 hp. each. Primary load structure is a 3/4" 7-8" shape and the aircraft makes intensive use of glass-fiber reinforced plastic. The entire upper fuselage from the tail to the windshield is a single plastic unit as are slatted wings. Beagle's new plastic version has 50% strength than required by the Registration Board. Fuel capacity is 30 imp. gal. in wing tanks airfoiled on the engine and fuel can be scooped from the cockpit. Flight instruments are centered on the panel with engine instruments on the right and radio on the left. Vario quadrant contains throttle, gear, and engine controls. Cruise speed at 10,000 ft. is 160 mph and max. with max. recommended cruise at 5,100 lb. is 175 mph at 7,000 ft. max. Maximum range with 90% fuel is 1,000 mi.





Engineered Environment

The British invent means has her own solution to the baby sitting problem. She sends her helpless and hairless young inside a heatball shielded nest suspended among reed stalks. The nest is high, dry and warm, yet well ventilated.

If environmental protection is important to your mission system, American Air Filter can help. We have proved the ability to provide Aeroplane Ground Support air conditioning systems in a combination with M11, B 375-63, GNE 07-59-5847A, 8-153-9, and other stringent specifications.

Recent project experience includes: Mustangs, A-10s, MiG 21s and F-4s. We are good in military needs and the design challenge of modern systems—from reheat through prototype to full scale production and installation. Inquire: Defense Products Division, American Air Filter Co., Inc., 320 Third Street, Rock Island, Illinois, Phone 755-9311.

Write for Bulletin AF-100

AAI
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SYSTEMS



PIPER CHEROKEE II will be offered in four models, ranging in price from \$12,900 to \$21,990. Plane is powered by a Lycoming O-360 engine.

Piper Displays New Model of Cherokee

Piper Cherokee II, priced with a 180 hp Lycoming O-360 engine and 172 and Cherokee II models, was announced last week by Piper at its international sales meeting in Hollywood Beach, Fla.

Increase in power, along with other changes, allows the Cherokee II to cruise at up to 250 mph, an increase over the Cherokee 110 and permits a top speed of 190 mph.

Cruise speed, Piper says, is 141 mph at 75% power at 3,000 ft. Fuel capacity

of 38 gal. is carried in two 25-gal wing tanks and gives the aircraft a normal cruising range of 750 mi.

Cherokee II will be offered in four models, ranging in price from \$12,900 to \$21,990.

The engine is installed on Dynaflex mounts to reduce vibration and an oil cooler has replaced the generator in the electrical system. Piper says the Cherokee II is the first low cost airplane to have an alternator which provides battery charging at engine idling speeds.

Gross weight of the Cherokee II is 3,400 lb. Useful load ranges to 1,175 lb depending on the version of the aircraft and the content of optional equipment.

All-metal aircraft retains the lines of earlier Cherokee models, except that wheel speed brakes are standard equipment on all models. Wing area and wing loading are well in excess of glass fiber or plastic in order to meet strict

Federal loading gear has a 10-ft. head and all legs have steel oleo shock struts and all the main 600 x 6 in.

The aircraft also is available in seven different color combinations. The Cherokee II is in production at Piper's Vero Beach, Fla., factory.

Piper Ending Policy Of Annual Changes

Piper Aircraft Corp. has discontinued its policy of annual model changes. Instead, Piper, vice president research and development, has announced: In the future, models will be changed only when sufficient modifications have accumulated to make such a change worthwhile.

Meanwhile, changes and improvements will be made from time to time of those desirable without changing the model designation, Piper said.

Cherokee II	
Engine	Lycoming O-360 A2A
	180 hp at 2,500 rpm
Gross weight	3,400 lb.
Empty weight (standard model)	2,527 lb.
Useful load (standard model)	1,175 lb.
Wing span	38 ft.
Wing area	868 sq ft.
Length	29 ft.
Height	7.5 ft.
Power loading	13.3 lb./hp.
Wing loading	13.3 lb./sq ft.
Engine capacity	38 gal.
Fuel capacity	50 gal.
Wing load	42 lb.
Wheel load	18 lb.

Performance

Top speed	190 mph
Cruise speed, 75% power	7,000 ft.
	141 mph
Stall speed, 80% down	57 mph
Takeoff run	775 ft.
Landing roll days down	600 ft.
Rate of climb	773 ft/min
Cruise range, 75% power	765 mi
30% power	710 mi



Sanborn data amplifiers

(Photograph courtesy of Sanborn — photo by J. H. H. H. H.)

(Photograph and price subject to change without notice — quote on J. H. H. H. H.)

Which amplifier characteristics match more closely to your overall system requirements — and pay for only the performance you need — by choosing from these newly developed, all solid-state DC data amplifiers now available from Sanborn. Ask your local Sanborn Sales Engineering Representative for complete specifications, application help and a copy of the Industrial Division Catalog — or write the Main Office in Waltham.

Wide Band, Floating Input—Floating Output "WFO"

Bandwidth DC to 0 db down at 10 MC • Input isolated from output • Max. gain 1000, smooth gain curves internally to range or switch out for indicated gain of 3000 to 10 • Input impedance 100 meg-ohm • At DC, output impedance 60 ohms • Output capability ± 50 V at 30 ms • Common mode rejection (2000 ohms in voltage input lead) 100 db at DC, 200 db at 60 cps • Linearity $\pm 0.1\%$ of 10 V full-scale at DC • Recovery from 100% overload in 300 usec to 1% of 10 output • Recovery from 20 V overload in 1 millisecond to 1% of 10 output • Model 500-4006 "WFO", \$625. Model 500-4006P (precision output ± 0.5 V at ± 100 ms, impedance less than 1 ohm), \$900.

DC—30 KC, 3-Terminal Floating Amplifier

Gain 1000 to 10 in 1, 2, 3 ratios; does not phase invert • Input impedance 100 meg-ohm at DC • Output ± 10 V at 180 ms, impedance less than 0.5 ohms • Linearity $\pm 0.01\%$ of 10 V output • Gain stability $\pm 0.01\%$ at DC at constant ambient for 40 hours • Model 500-4000, including internal power supply, \$550.

Narrow Band, Floating Input — Floating Output

Bandwidth DC to 0 db down at 100 cps • Optional plug-in output filter in front bandwidth • Floating input isolated from floating output • Gain 1000 to 20; Band stop attenuator, gain trim and zero trim controls • Input impedance 200,000 ohms min., output impedance 75 ohms • Output ± 5 V at 1.5 ms • Linearity $\pm 0.15\%$ of 1 V output • Recovery from ± 10 V overload in 200 ms • Common mode rejection (1000 ohms in either input lead) 120 db at 50 cps • Model 500-4300, \$435.

THE INDUSTRIAL DIVISION OF
SANBORN COMPANY
170 Myrtle Street, Waltham 24, Massachusetts
A DIVISION OF ELECTRIC THERMODYNAMICS COMPANY

Information About Hose Made of Teflon From The People Who Invented It

No. 2 in a series

ORIENTATION AND HOSE OF TEFLON

One of the many important parameters that a knowledgeable manufacturer of Teflon® hose tubing controls is the orientation of the building blocks of the resin, often called crystallites. It is generally understood that the specific technique of extrusion has influence over the degree of orientation of the particles; not so common is the knowledge that the subsequent manufacturing steps, sintering, etc., are far more important than extrusion for controlling properties of the tubing.

Recently spiral extrusion techniques have been advocated as a method of improving hose tubing. Co-rotation of male and female dies during extrusion produces two spirally oriented layers of particles. However, Teflon tubing structure is determined at the micro level, and the post-extrusion processing steps exert greater influence in this area than specific arrangements of bands of particles. In other words, two-directional orientation (two massive bands of oriented particles), by itself, is still far from true "random

orientation" of the little building blocks.

Maximum randomizing during the manufacturing operation provides the highest level of performance in terms of flex life, fatigue resistance and all the other desirable mechanical attributes of good tubing. The freedom from spiral deformation, cleavage planes and circumferential fracturing afforded by maximum randomizing is not easily attained. Although this implies that manufacturing operations are critical, such is not the case, since the control of the manufacturing process, although strict, is relatively routine after knowledge and understanding of the product have been achieved.

First recognized and defined by Resistoflex when they originated hose of Teflon nine years ago, sintering and post treatment have emerged as the dominant levers of control in the manufacture of quality aerospace Teflon hose. They have proved to be two of the valuable tools which keep our hose out in front as the standard of the aerospace industry.

Resistoflex makes its best made of Teflon under the trade name Resistoflex which are Resistoflex 718

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FINANCIAL

Financial Briefs

Hevlett-Packard Co. reported net earnings of \$5,534,000 for the nine months ended July 31, on sales amounting to \$80,154,080. Comparable figures for the same period in 1961 were \$4,102,000 net earnings on sales totaling \$63,416,400.

Ryan Aeronautical Co. showed a net income of \$2,150,054 for the first three quarters of the company's fiscal year. Net sales were \$32,756,150. Figures represent a decrease from comparable period in 1961, when net income of \$2,176,174 was reported on net sales of \$27,810,487.

Corbett Corp. reported net earnings of \$5 million on \$285 million in consolidated sales for its fiscal year ended June 30. Last year's net earnings were \$1,414,000 on consolidated sales of \$159 million.

Marshall Industries showed net earnings of \$9,521,583 on consolidated revenues of \$9,525,414 for the company's fiscal year ended May 31. Figures for a comparable period in 1961 were net earnings of \$123,662 on consolidated revenues of \$1,695,296.

Missile Systems Corp. reported earnings of \$316,772 on net sales and other income of \$1,106,524 for the three-month period ended July 31. Income for the same period in 1961 was \$451,019 on sales of \$1,909,255.

Labentary For Electronics, Inc., had net earnings of \$10,600 on sales of \$2,335,000 during the first quarter of the company's fiscal year.

International Telephone and Telegraph Corp. reported earnings of \$89.9 million on sales and revenues of \$107 million for the first half of 1962. Comparable 1961 earnings were \$17 million on sales and revenues of \$413.5 million. Order backlog on June 30 this year was \$775 million compared with \$656 million on the same date last year.

Fairchild Sales Corp. reports \$1.5 million earned on sales of \$51.6 million for the first six months of 1962. Same period last year showed \$1.6 million earned on sales of \$39.7 million.

General Precision Equipment Corp. showed a net income of nearly \$1.9 million for the first six months of 1962—compared with nearly \$2.5 million for the same period last year. Sales for the

WRIGHT SPERRY GYRO ELEMENTS
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DIVISION OF CHRYSLER CORP. CORPORATION
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- Foucault Synchron, Resolvers
- Torques, Spin Motors
- Micropower, Pick-Offs

PROBLEMATICAL RECREATIONS 138



At the local yachting club they were checking over their equipment in preparation for the coming season. Woodcock, a traditionally minded member, reminded that the two sails on his boat shared a common property: the area of each in yards was equal to its perimeter in yards. Both sails, it should be mentioned, were of the usual right triangular shape and were of different dimensions. What must have been their area? —Contributor

Digital computer engineers in the airborne area are invited to apply to our Guidance and Control Systems Division. We are particularly interested in design innovations for airborne digital computers that will work well with inertial guidance systems, navigation systems, and advanced flight data systems. If you prefer to talk to Mr. Donald F. Kruse who will arrange a personal interview at your convenience.

ANSWER TO LAST WEEK'S PUZZLE: My house number is 204, and there are 288 houses in my road.

An Equal Opportunity Employer
LITTON SYSTEMS, INC.
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Woodland Hills, California



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Unique in its coverage of the entire aerospace market, the 1983 **BUYERS' GUIDE ISSUE** has been completely revised to meet radically changing industry patterns.

Products, systems and services of over 3,000 manufacturers will be listed in one easy-to-read section covering satellites, space vehicles, missiles, aircraft, avionics, marine and support equipment, supporting equipment and services. Appearing on timed paper for fast identification and greater readability, this section will contain more than 2,000 newly revised categories with names of manufacturers listed under each category.

Greatly expanded editorial reports on procedures for selling to Department of Defense agencies and the National Aeronautics and Space Administration will include names, addresses and telephone numbers of government officers concerned with aerospace procurement.

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HOLLEY
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Factbook Book.

A-31 A

Division of
HOLLEY CARBURETOR CO.

1289 E. Hulse Mills Road, Dept. A, Warren, Michigan

1962 period were \$108 million compared with \$119 million for the same period last year.

Aeroquip Corp. sales for the nine-month period ended June 30 were \$43.8 million, with earnings of \$3.5 million. Same period last year showed sales of \$35.3 million accompanied by earnings of \$1.1 million.

Westinghouse Air Brake Co., and subsidiaries, showed consolidated net earnings of \$401 million on sales of \$93.5 million during the first six months of 1962. First half of 1961 showed earnings of \$405 million on sales of \$85.2 million.

American Bank Note Corp. reported earnings of \$3.5 million during the first half of 1962 compared with earnings of \$3.2 million for the first half of 1961. Sales for the two periods were \$64.1 million this year compared with \$71.1 million for last year.

Royal Industries, Inc., of Pasadena, Calif., showed net earnings of \$161,908 on sales of \$8.7 million for the six months ended June 18. Same period last year showed \$134,045 earned on sales of \$5.2 million.

Eltron Industries reported a 28% gain in sales and a 95% increase in earnings for the fiscal year ended July 31. Sales totaled \$194 million and earnings of more than \$16 million. Last year's sales were \$278 million, with earnings of \$30.1 million.

United Electrodynamics, Inc., of Pasadena, Calif., earned \$75,970 on sales of \$7.1 million for the first half of 1962. Last year's earnings for the comparable period were \$61,527 on sales of \$5.3 million.

Coast Hydrolics, Inc., of Los Angeles, reported earnings of \$82,740 on sales of \$2.4 million during the first half of 1962. Earnings for the same period last year were \$126,156 earned on sales of \$2.3 million.

Sperdy-Rand Corp. showed a net income of \$1.46 million on sales of \$180.5 million for the quarter ended June 30. Last year's totals for the same period included net income of \$4.29 million on sales of \$268.6 million. Working of defense orders stood at \$619 million as of June 30.

Pascetti Aircraft Corp. reported earnings of \$175,945 on sales of \$1.1 million for the fiscal year ended June 30. Corresponding 1961 figures, including earnings of \$79,835 on sales of \$1.6 million. Order backlog on June 30 totaled nearly \$5 million.



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or to arrange
a meeting.

A-31 A

Mergers and Acquisitions

General American Transportation Corp., of Chicago, has bought American Machine & Foundry Co.'s Mechanical Research Division of Niles, Ill. The ARD division is engaged in advanced research and development for defense and industry and will continue this work for General American Transportation. AMT and the sale was in line with plans to concentrate its Government Contract research and development around General American Steel, Chicago.

Whitman Molding Controls, of Corona, N. Y., has acquired Corbin Products, a fabricator of rubber products. The new facilities are being used to make sheet rubber stock, molds, including shock mounts for motor stopping cushions.

Aeronomy Products Co., Whittier, Calif., a division of Textron, Inc., has acquired Fuel Engineering and Controls Co., of Torrance. Fuel Engineering manufactures fuel nozzles, fuel heat exchangers and engine components.

Delta Microwave Corp., of Glenside, N. J., a manufacturer of precision microwave components, has been acquired by Hughes Manufacturing Co., of Milford, N. H. Delta will be operated as a wholly owned subsidiary and retain its present management.

Barrington Corp., of Detroit, has acquired General Engineering Co., of Ann Arbor, Mich. General is an electronics research and engineering company specializing in data display systems. General, formerly owned by Dames & Moore, Inc., will be operated as a Michigan unit of Barrington Laboratories.



Raft-Sleeping Bag

Coupled with soft sleeping bag developed by Air Crews Division of General Corp. for USAF has a radio receiver—ultrasonic receiver which covers the occupant while in a drifting position. A CCB, or inflatable raft while the occupant is asleep by mouth.



What else can you do with
the highest density,
practical metal
available for aircraft
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At the LOCKHEED-GEORGIA COMPANY you will enjoy the challenge of new projects in the aircraft industry. Our Engineering Branch is currently working on the new C-141 tubular airframe program, new versions of the C-130 Hercules transport, the C-130J tactical utility transport, the Humvee VTC, aircraft for the Army, nuclear and aerospace research, and a number of other long-range projects which offer unlimited future and professional growth for the ENGINEER.

We offer IMMEDIATE openings for Specialists, Senior Engineers, Engineers, and Recent Engineering Graduates in the following areas:

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AIRCRAFT LIAISON ENGINEERS

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websites will be the connecting link between the appropriation accounts (budget) and the program. In addition, the budget books or appropriation accounts will also be kept in terms of new obligatory authority (NOA) and expenditure authority.

In order to simplify the relationship between the program structure and the budget structure, we are trying to align the resource categories as annexes of the major programs with the subelements of the appropriation accounts so that, in the maximum practicable extent, the two structures will be compatible. This has... been accomplished as the research and development area.

"As you know, there are four principal Research and Development Test Evaluation appropriations, one each for the Army, Navy, Air Force, and one for the Defense Agencies.

"The first principal RDT&E appropriation has been divided into a total of about 345 subactivities which are identical in both the budget structure and the program structure. These 345 subactivities are aggregations of some 1,600 technical projects, which, in turn, are aggregations of something on the order of 13,000 individual tasks from which then the tens of thousands of... contracts and job orders financed each year by the RDT&E.

"You will recognize that the key point for fiscal control, both for budgeting and programming purposes, is the RDT&E subactivity. We have established individual funding levels for each of the 345 subactivities for FY 1982. Any change from these amounts in excess of 5% either must be specifically approved by the Office of the Secretary of Defense, and amounts not approved, or deferred for obligation, may not be obligated for any purpose without such specific approval. We will, of course, also account for obligations incurred against each of these 345 subactivity accounts.

"A similar effort is now being made in the military contractors and procurement area. If we can successfully align the resource categories representing the programs with the contents of the appropriation accounts in the same manner as we have in the RDT&E area, fiscal control over both the program and the budget can be achieved as a single integrated system. And as long as the resource categories are accurately related in the program accounts, dual control over the contents of both the program and the budget can be exercised simultaneously.

"In the case of program elements, not reporting and controls are being designed presently to relate physical performance—i.e., program is achieving the objectives of each program—to total cost to complete the development... and the annual cost of operating it."



Another first from Flexonics...

Flexible ducting length changes, but volume and pressure stay constant!

Developed by Flexonics for the Saturn C-1 vehicle, the universal flexible ducting section shown here is an R&D unit designed to deliver air at LOX to the gasified oxidant engine. As these engines, sure to replace gas turbine engines, the fuel and LOX lines must provide for change of unit length, between engine and tank, up to 14'.

Problem: Design and build flexible ducting for the application so that whatever the engine position, whatever the length of duct, the volume of the system remains constant. Why? Because volume change could mean pressure change, and thus in turn could cause catastrophic loading on fuel and LOX pumps. Constant engine performance depends on uniform supply of fuel and LOX to the pumps.

Flexonics engineers, working with engineers of the George C. Marshall Space Flight Center of National Aeronautics and Space Administration, Huntsville, Alabama, were equal to this challenge.

This arrangement of compensator bellows permits an axial stroke of $\pm 56\%$ of the free length of the compensator flex. The internal construction of the compensator flex provides for pressure compensation, during motion, the equal and opposite movement of the flex maintains a constant volume in the duct, as a piece of motion.

The use of this combination of compensator and bellows eliminates slip and thrust due to internal pressure. As a result, any change loading on the pump is then due only to acceleration forces.

The Flexonics constant-volume-compensated flexible connector was a fully developed and proved. Its unique principle is ready to be adapted to your mobile or rocket driving application. No need to look further than the one manufacturer now qualified to supply flexible ducting assemblies and systems for NASA's mighty Satans.

FREE MODEL shows volume-compensating principle of Flexonics Pressure-Volume Compensator.

We've prepared a simple credit-card sized card describing the volume-compensating principle of this unique ducting element. Mail the coupon for your copy.

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...not a bad sentiment for a job, either

In May of this year, a comprehensive program was instituted by General Electric to strengthen every employee's awareness of the entire nature that should be built into every G.E. product—whether it's a stock radio or a constant-speeding conveyor and control system.

But there's no reason why this program should be limited to products. For years General Electric, and its Defense Systems Department have placed the "Accent on Blue" on professional positions as well. For example:

ACCENT ON PROGRAM DIVERSIFICATION—To clearly identify some of the program areas in DSD's 412,000 sq. ft. advanced development plant, we open various departments to personnel in other weapons control. **SYSTEM** is a revolutionary program integrating measurement systems with important developments in space vehicle terminal guidance. **SECURITY** (STT) will be a national security defense director and measurement device. **MUSCLE AND SPACE VEHICLE GUIDANCE** is the input network of our advanced guidance system in developing the ALCAL (Anti-Submarine Warfare) System, currently used for nuclear guidance on the majority of America's space ships, including Project Mercury.

ACCENT ON TECHNICAL SUPPORT—The tools to get the job done. Among them is computer facility of 7 general purpose machines; capable in one second and capability from minutes to the fastest large-scale sequential computer systems. This is supported further by DSD's specially designed GDSM facility—a common making of special purpose digital equipment with an output capacity of 500 conditions.

Forward your resume in strict confidence to Mr. P. W. Williams, Jr., person: Defense Systems Dept., General Electric, Western Lights Office Bldg., Syracuse, N. Y.



ACCENT ON PROFESSIONAL DEVELOPMENT—Full tuition support for graduate work at Syracuse University. (75% of our engineers and scientists currently participating) Educational levels at research limited to constant attendance. We also conduct over 100 in-plant professional courses, lasting from 33 to 26 weeks. DSD works closely with the professional facilities, supporting roundtable and seminars, encouraging career progression and advancement for our professional people.

ACCENT ON PERSONAL REWARDS—DSD's salaries are fully competitive at every professional level. What's more, a clearly defined salary range includes each level of responsibility. Based on individual performance, your compensation can increase as much as one-third, within your current position discipline. And it offers promotion to broader responsibilities that the upper half of your salary entitles you.

IMMEDIATE OPENINGS—The job is somewhat long, a reflection of DSD's constant expansion with new areas of technological activity. If you can identify yourself by title of subject, we'd be happy to reply promptly. Our attempt to find the specific position that best matches your immediate interests and long-term goals.

Communication Systems / Applied Mathematics / Systems Engineering / Microelectronics Electronic Packaging / Semiconductor Growth Design / Computer Systems Applications / Electronic Linear Production Engineering / Microelectronics Mechanical Design / Operations Analysis / Systems Equipment Analysis / Telecommunications Systems Design / Project Management Engineering / Equipment Evaluation

GUIDANCE & CONTROL ANALYSTS

The forthcoming Douglas Space Simulation Facility will provide outstanding facilities for R&D programs in your field. Contact us regarding these considerable openings of importance.

SIMULATION SPECIALIST

To develop requirements for aerospace control systems and display inputs for guidance and control considerations. Participations in studies of guidance and control systems for advanced space vehicles and development of a simulation facility will be features of this assignment. Related experience, including participation in the design and procurement of a major simulation facility, is preferred. Ph.D. or M.S. preferred.

FILTER DESIGN SPECIALISTS

To assist control system designers in synthesizing compensating filters for advanced space vehicles and to conduct research in advanced methods of filter synthesis. M.S. in electrical engineering and related experience preferred.

SPACE VEHICLE DYNAMICS

To investigate the dynamics of large space stations and payloads as they affect vehicle design. Free bending, preflight loading, spacecraft design, and loading dynamics are among subjects to be studied. Further experience and/or an M.S. in mechanical engineering or physics are preferred.

Write for complete information (include resume of background) to: P. W. Williams, Dept. 11, Missile and Space Systems Division, Douglas Aircraft Company, Inc., 2025 Oliver Park Blvd., Santa Monica, California. An equal opportunity employer.



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System is all-electric, eliminating need for liquid nitrogen and water and no service. System offers complete freedom from oil contamination, the manufacturer says, and is capable of vacuum of 1×10^{-9} torr, weight, without helium.

Utah Corp., 109 Commercial St., Palo Alto, Calif.

Gas Velocity Meter

Meter (VM-1) registers velocity of jets, gases, or flow from hypersonic gas flow from 2,000 to 50,000 ft/sec.

Instrument incorporates a single adjustable control that provides the operator with instantaneous and continuous direct reading of gas velocity in both per second or in time intervals between known points.

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MHD Research, Inc., P. O. Box 8115, Newport Beach, Calif.

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The large advanced Saturn will stand about 350 feet high and measure 33 feet in diameter. Its takeoff weight is estimated at approximately six million pounds. The Boeing first-stage booster, powered by a cluster of five engines, will have a total thrust of 7.5 million pounds.

Boeing's newly formed Saturn Booster Branch has a number of long range openings offering exceptional ground floor opportunities. Immediate assignments are available to engineers in the following fields of interest: aerodynamics, structures, electronics, propulsion, systems test, automation, reliability, vibrations, acoustics, loads, support equipment and electrical, as well as cryogenics, stress analysis and thermodynamics.

Assignments will be in New Orleans or Huntsville, Alabama. Other Saturn openings — as well as assignments on such additional Boeing missile and space programs as the Minuteman ICBM and the Dyna Soar boost-glide vehicle — are available at Seattle, Cape Canaveral and Vandenberg AFB. Boeing pays liberal travel and moving allowances to newly hired engineers.

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Stress & Basic Loads

FOR INFORMATION

Candidates are invited to send their detailed résumé, including highest salary with each past employer and present salary to Professional Placement Staff, Dept. 1310H, Lockheed-California Company, 2405 North Hollywood Way, Burbank, California. Liberal travel and moving allowances will be paid to those employed.

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FORM BEGINS ON PREVIOUS PAGE

EMPLOYMENT HISTORY (Attach Summary)

Employer Name and Address	From (Month and Year)	To (Month and Year)	Position Held
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____

REFERENCES (Give full names, occupations and addresses of Professional (previous superior preferred).)

1. _____

2. _____

Character (after last relative or former employer): _____

1. _____

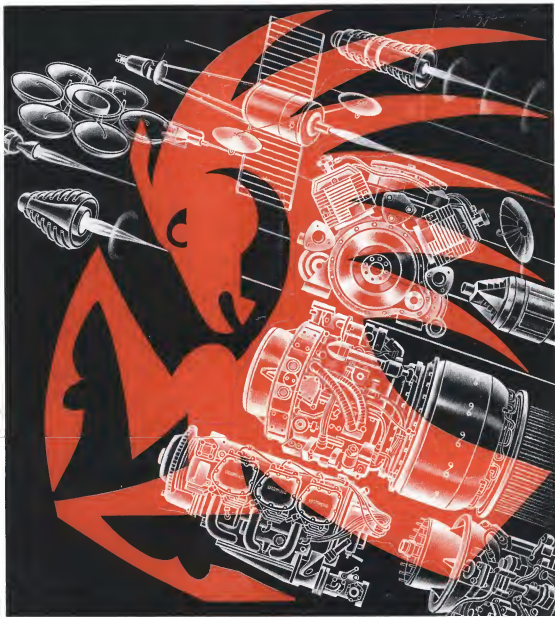
2. _____

LIST TYPE OF WORK PREFERRED UPON EMPLOYMENT:

Have you ever been cleared for classified military information? _____ If yes, give date, level and company.

May we contact your former and present employers prior to completion of employment negotiations? Yes _____ No _____ If "yes," I authorize, without liability, the release of all employment and personal information.

RETURN TO: MR. W. L. HAYS, THE BOEING CO.
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